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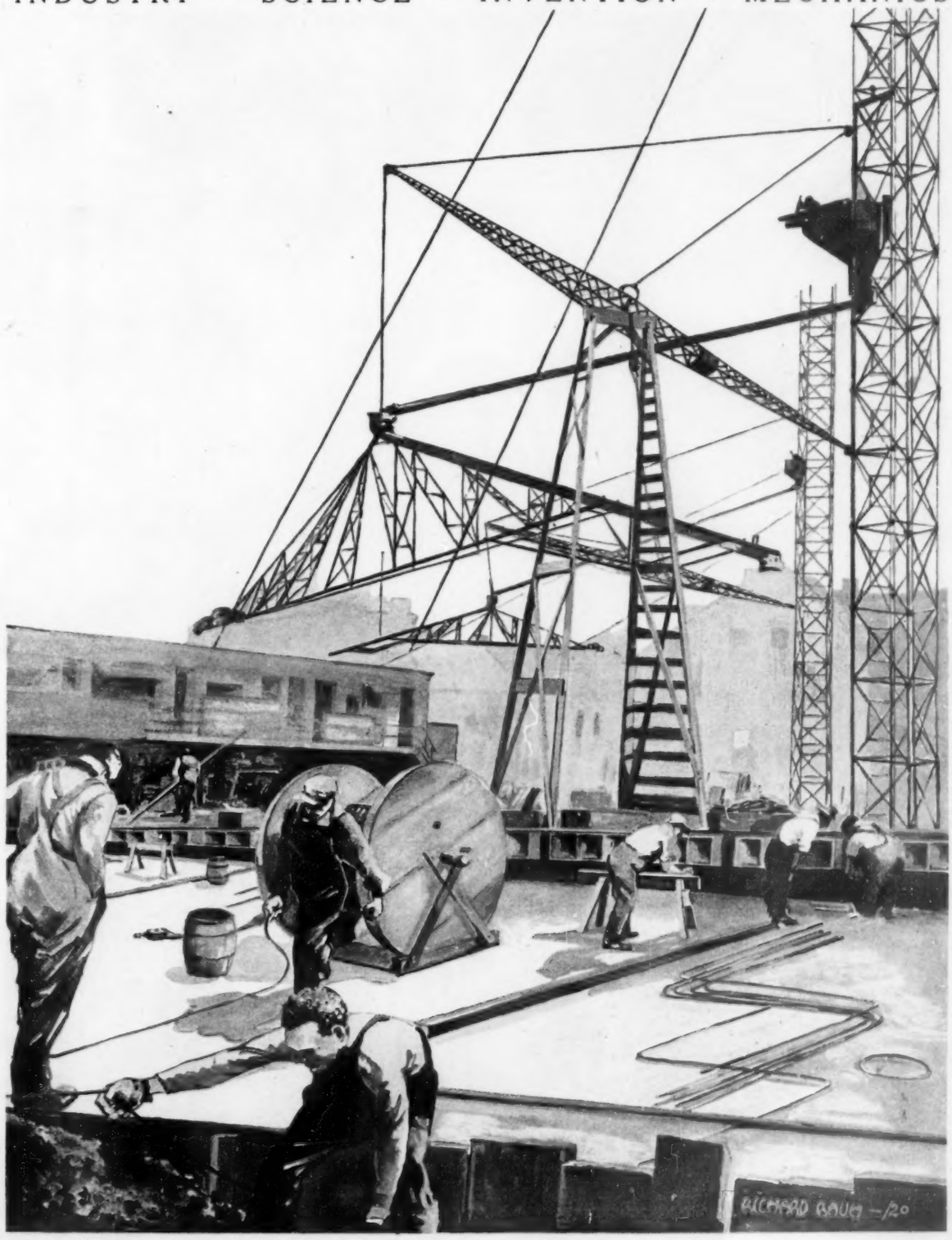
PREVENTING RUST AT HIGH TEMPERATURES

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



PUTTING GRAVITY TO WORK IN THE ERECTION OF CONCRETE BUILDINGS.—[See page 398]

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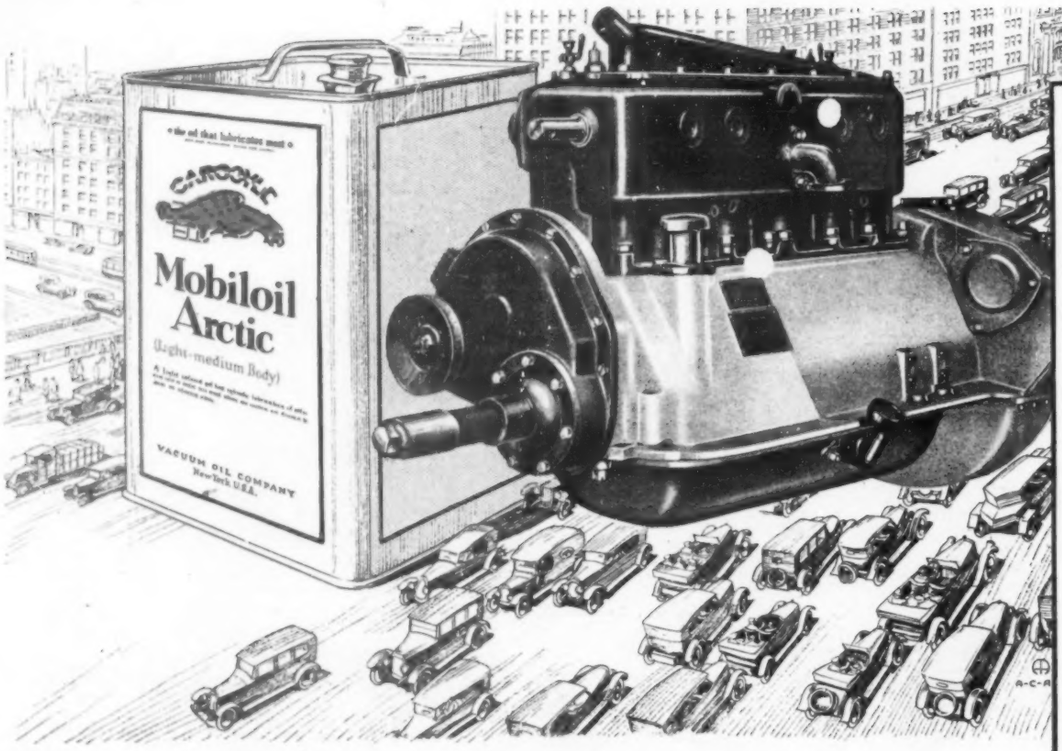

FOR YOUR CONTINENTAL MOTOR

Three factors which explain the superior results obtained from Gargoyle Mobiloil Arctic

IF you select a car with a Continental Motor you look for engine results. Continental Motors are the standard equipment today in nearly 200 models of passenger cars and motor trucks.

The most important single factor in the efficient operation of your engine is Correct Lubrication.

The Vacuum Oil Company's Board of Automotive Engineers has carefully analyzed the lubricating requirements of all types of Continental Motors and has determined the correct lubricant to meet these lubricating requirements with scientific exactness.

This correct lubricant is Gargoyle Mobiloil Arctic for all models except the "B-2" and "T" motors that are used in certain models of trucks, for which the correct oil is Gargoyle Mobiloil "A."

SOME features of design and the conditions under which Continental Motors operate, influencing the choice of a lubricant, are:

1—Moderately high piston speeds.

2—Close-fitting pistons and well-finished cylinder walls, made possible by expert workmanship and exact production methods.

3—Well-jacketed, vertical cylinders, preventing excessive cylinder wall temperatures.

Taking these points into consideration, together with other important features of design and construction, an oil of the character and body of Gargoyle Mobiloil Arctic is best adapted to provide perfect cylinder lubrication, properly seal the piston rings against gas and fuel leakage, and minimize carbon formation.

In addition to meeting these conditions, Gargoyle Mobiloil Arctic is of the proper fluidity to be distributed through the lubricating systems in Continental Motors, providing adequate lubrication for every bearing surface.

With Gargoyle Mobiloil Arctic in your Continental Motor you will secure full power and the minimum cost per mile for gasoline, oil and repairs.

GARGOYLE

Mobiloils

A grade for each type of motor

Domestic Branches: New York Boston Philadelphia Pittsburgh Detroit Chicago Minneapolis Indianapolis Kansas City, Kan. Des Moines

Chart of Recommendations *for* AUTOMOBILES

(Abbreviated Edition)

GARGOYLE

Mobiloils

A grade for each type of motor

How to Read the Chart

THE Correct Grades of Gargoyle Mobiloils for engine lubrication are specified in the Chart below.

A means Gargoyle Mobiloil "A"
B means Gargoyle Mobiloil "B"
E means Gargoyle Mobiloil "E"
Arc means Gargoyle Mobiloil Arctic.

These recommendations cover all models of both passenger and commercial vehicles unless otherwise specified.

Where different grades of Gargoyle Mobiloils are recommended for summer and winter use, the winter recommendation should be followed during the entire period when freezing temperatures may be experienced.

This Chart is compiled by the Vacuum Oil Company's Board of Automotive Engineers, and constitutes a scientific guide to Correct Automobile Lubrication.

If your car is not listed in this partial chart, consult the Chart of Recommendations at your dealer's, or send for booklet, "Correct Lubrication," which lists the Correct Grades for *all* cars.

NAMES OF AUTOMOBILES AND MOTOR TRUCKS	1920		1919		1918		1917		1916	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Arlan	A	Arc	A	Arc	A	Arc	A	Arc		
Brewster	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Buick	A	Arc	A	Arc	A	Arc	Arc	Arc	A	Arc
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac	A	A	A	A	A	A	A	A	A	A
Chalmers (6-40)									Arc	Arc
" (6-40)									A	Arc
" All Other Models	A	A	A	A	A	A	A	A		
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet (8 cylinder)			A	A	A	A	A			
" (FA)			A	A	A	Arc				
" (FB & 1 ton)	A	Arc								
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cleveland	A	Arc								
Cunningham	A	A	A	A	A	A	A	A	A	A
Dixie Flyer	A	Arc	A	Arc	A	Arc	A	Arc		
Dodge Brothers	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Essex	A	Arc	A	Arc						
Federal (Model 5-X)					A	A	A	A		
" (Special)					Arc	Arc				
" All Other Models	Arc	Arc	Arc	Arc	A	A	Arc	Arc	Arc	Arc
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
G. M. C. Trucks	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Grant (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (Com.) Model 12)			A	Arc						
" " All Other Models	Arc	Arc	Arc	Arc						
Haynes (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(12 cylinder)	A	A	A	A	A	A	A	A	A	A
Holmes	B	A								
Hudson Super Six	A	Arc	A	Arc	A	Arc	A	Arc	A	A
" All Other Models									Arc	Arc
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Jones	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Jordan	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
King (8 cylinder)	A	A	A	A	A	A	A	A	A	A
Kissel Kar (Model 66)									A	A
" " (12 cylinder)					A	A	A	A		
" " All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Liberty	A	A	Arc	Arc	Arc	Arc	Arc	Arc		
Locomobile	A	E	A	E	A	E	E	E	E	E
Lafayette			Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Maccar (3½ ton)	A	A	A	A	A	A	A	A		
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Maxmon	A	A	A	A	A	A	A	A	A	A
Maxwell	A	A	A	A	A	A	A	A	A	A
Mercer	A	A	A	A	A	A	A	A	A	A
Mitchell (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cylinder)									A	A
Moline-Knight			B	A	B	A	A	A	A	A
Monroe (Model M 2)									E	E
" " M 3)					Arc	Arc	A	Arc		
" All Other Models	A	A	A	A	A	A	A	A		
Nash (Quad)	A	A	A	A	A	A				
" (Model 671)					A	A				
" All Other Models	A	Arc	A	Arc	A	Arc				
National (6 cylinder)	A	A	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (12 cylinder)			A	A	A	A	A	A	A	A
Nelson	A	A	A	A	A	A	A	A		
Noble	A	A	Arc	Arc	Arc	Arc	Arc	Arc		
Oakland (8 cylinder)									A	A
All Other Models	A	A	A	A	A	A	Arc	Arc	Arc	Arc
Old Hickory	Arc	Arc	Arc	Arc	A	Arc	A	Arc	Arc	Arc
Oldsmobile (4 cylinder)	Arc	Arc	Arc	Arc					Arc	Arc
" (6 cylinder)	A	A	A	A	A	A	Arc	Arc		
" (8 cylinder)	A	A	A	A	A	A	A	A	A	A
Oshkosh	A	Arc	A	Arc						
Overland	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard	A	A	A	A	A	A	A	A	A	A
Paige (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (Conc. Eng.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" All Other Models	A	A								
Pan (Model A)	A	Arc	A	Arc	A	Arc				
" (Model 250)					Arc	Arc				
Peerless (8 cylinder)	A	A	A	A	A	A	A	A	A	A
" All Other Models					Arc	Arc	Arc	Arc	Arc	Arc
Pierce Arrow	A	A	A	A	A	A	A	A	A	A
" (Com.) (5 ton)	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" " All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	A	A	A	A
R & V Knight	B	A								
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Riker	E	E	A	E	A	E	E	E		
Rock Falls	A	Arc	A	Arc						
Sanford	Arc	Arc	Arc	Arc	A	A	A	Arc	A	Arc
Sayer			E	E	E	E	E	E	E	E
Scripps-Booth (4 cylinder)					Arc	Arc	A	Arc	A	Arc
" (6 & 8 cylinder)	A	A	A	A	A	A	A	A	A	A
Stearns-Knight	B	A	A	A	B	A	A	A	A	A
Studebaker	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Templar	A	A	A	A	A	A				
United (Grand Rapids, 1-2 ton)	A	A	A	A	A	A			Arc	Arc
" " " (3½ ton)	A	A	A	A	A	A	Arc	Arc	Arc	Arc
" " " (5 ton)			A	A			A	A		
" " " (5 ton)	A	A	A	A	A	A	A	A	A	A
" " " (6 ton)			A	A						
" All Other Models	A	A	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Velie (4 cylinder)	A	Arc								
" (6 cylinder)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Com.) (1½ ton)			A	Arc	A	Arc				
" " All Other Models	Arc	Arc	Arc	Arc	Arc	Arc				
Vim (Models 22, 23 and 24)	A	A	A	A						
" (Model 35)	A	Arc	Arc	Arc						
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Wentworth	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White (16 valve)			A	A	A	A	A	A		
" (12 valve)			A	A	Arc	Arc				
" All Other Models			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Willys-Knight	B	A	B	A	B	A	A	A	B	A
Willys Six	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Winther Six	A	Arc								
" (Com.)	A	A	A	A	A	A	A	A		
Winther-Marmon (1½ ton)	A	A	Arc	Arc						
" All Other Models	A	A	A	A						
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

VACUUM OIL COMPANY — *Specialists in the manufacture of high-grade lubricants for every class of machinery Obtainable everywhere in the world* — NEW YORK, U.S.A.

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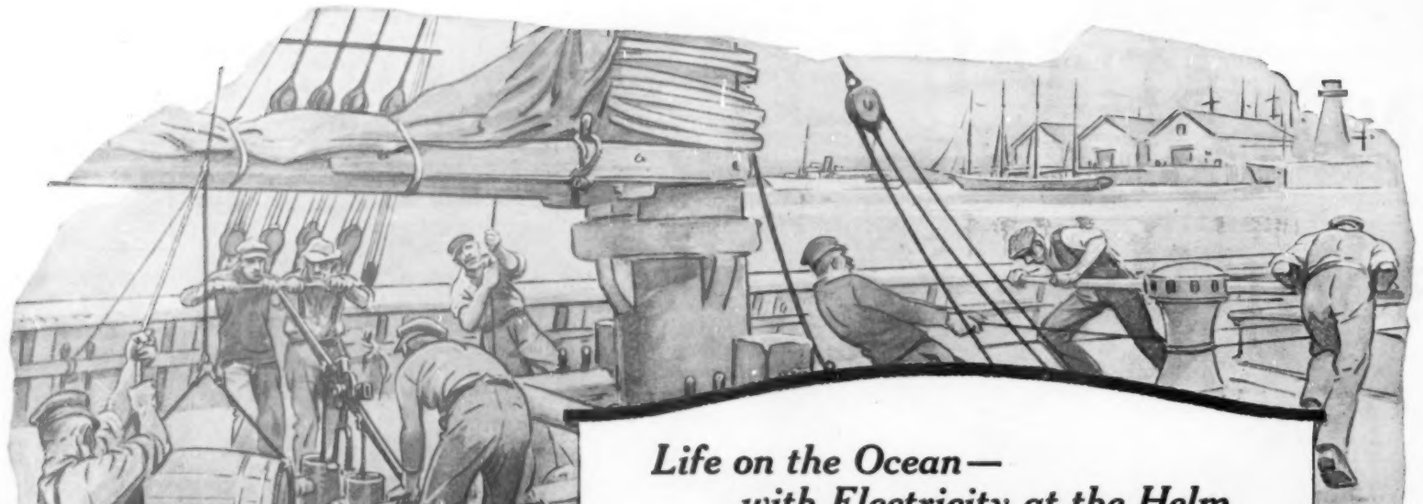


Life on the Ocean— with Electricity at the Helm

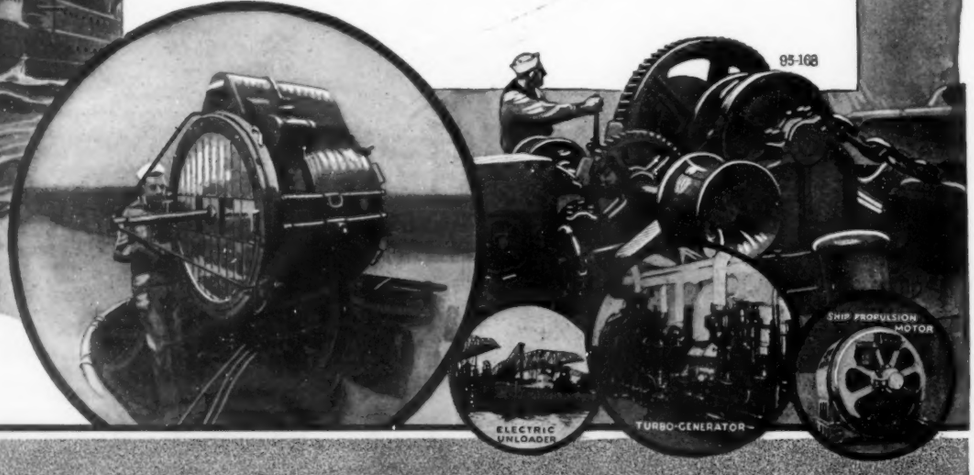
IN the old days before the mast, weighing anchor, pumping ship, and "keeping her before the wind" were tasks for brawny men who knew neither fear nor fatigue.

The old sea was rated in terms of man power, while the new sea is measured in horse power, with electricity as the controlling force. Imagine a great electric city afloat, where tasks are simplified, where safety is assured, and where convenience and comfort are present at every turn. Such is the modern electric ship; the New Mexico or the California for example. Electricity is the source of all things good from stem to stern.

With oil for fuel, a central power plant generates sufficient energy to propel the massive vessel, to furnish light for every purpose, and power for every need. Searchlights, signals, steering apparatus, wireless telegraphy, pumps, capstans, winches, hoists, cranes, drills, welders, rivet heaters, cooking appliances, and a hundred other devices for making work easy and protecting human life—all with one source of power that is safe, clean and *always available instantly*.

Whether at sea or in port, the work of a sailor and the comforts of a passenger are enhanced by the proper application of electricity. Cargoes are loaded and unloaded quickly and efficiently. Repairs are facilitated, and the ship is kept in active service over longer periods, thus aiding commerce and world distribution to a marked degree.

Such a development has not been simply a question of designing and building the necessary equipment for marine electrification. It has devolved upon some manufacturer to look well into the future and visualize the needs aboard ship, and then to engineer the machinery into those needs. In this capacity the organization, experience and facilities of the General Electric Company are serving the American Navy and the American Merchant Marine.



GENERAL ELECTRIC COMPANY

SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

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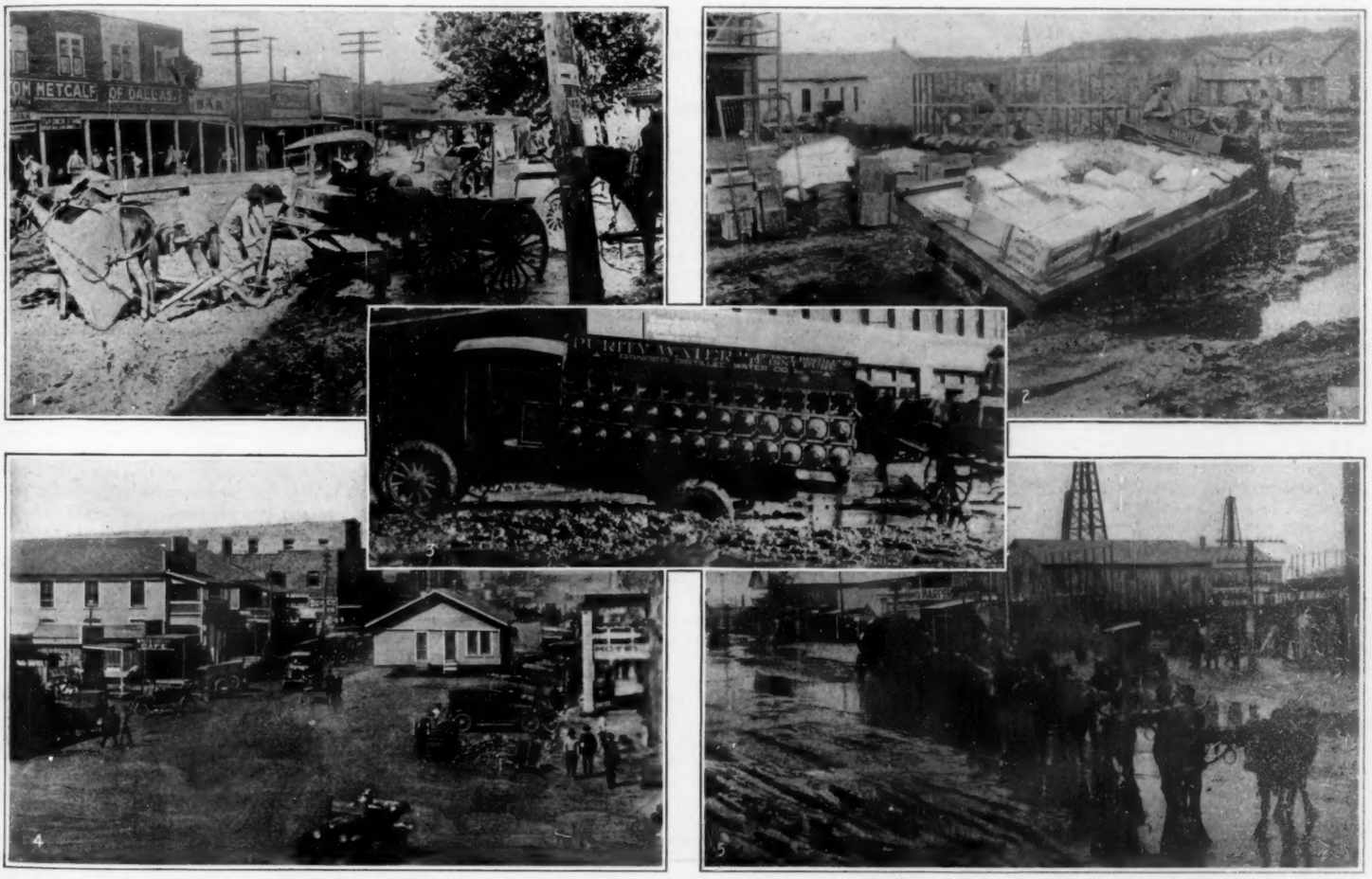

1. A typical oil town showing conditions under which motor traffic is at a discount. 2. Big truck stuck in the mud of a main street. 3. Making heavy going of it in the Burkburnett field. 4. The main street of a big oil boom-town. 5. Desperate remedies that are resorted to, to restore traffic

Representative scenes in the mud roads and streets of the Texas oil district, showing some of the transportation difficulties that add to the price of petroleum products

Transportation in the Oil Fields

By Edmund Conaway

IN the great oil fields of the country there are many different forms of transportation. In the mountainous districts of the country most of the hauling within the fields is done by teams, while within the more level country it is done by trucks, tractors and caterpillars. I do not mean to leave the impression that no teams are used in a level country, because in a great oil field there is plenty of hauling for all. In the great fields of the Southwest there are thousands of teams and trucks. I remember one day having passed seven hundred teams upon a road connecting two towns, thirty-five miles apart. One of these was a shipping point and the other was the center of a large oil field. Upon this same road were many trucks, also tractors and caterpillars. In good weather trucks are always busy and occasionally some teams are idle on this account, but in bad weather the teams do the greater part of the hauling.

Trucks and trailers of every make are used. It is a common sight in Central Texas to see a tractor pulling a boiler and two wagons loaded with casing. The expense of transportation is greatly due to the distance material must be hauled and to the bad roads. It is estimated that where the depth of wells is at least 3,200 feet the cost of hauling material by teams and trucks will average $8,000.

The roads throughout the oil fields of the Southwest have been very bad. At times the only hauling that can be done is by horses, mules and oxen, and often but few teams will venture out. In traveling upon the main roads it is a common sight to see trucks, cars of all makes and wagons stuck in the mud. Ordinarily trucks and teams travel together in order to help one another. Upon one occasion when a driver with four mules got stuck in the mud, it being almost dark with no help near, feeling that his animals were safe he went away and staid until morning.

One man is not bothered by bad roads—the owner of the airplane. A few wealthy men of the West and Southwest visit their holdings in this manner. At Casper, Wyoming, last summer an agency was established to sell airplanes to wealthy oil and cattle men.

These great trucks and tractors are extremely hard on roads. In order for one to have some idea of the roads either in dry or wet weather it is necessary to travel over them. In dry weather they are extremely rough and in wet weather they are lakes of water and mud.

The streets are often excellent examples of the muddiest oil field roads, due to much heavy hauling and rain. In 1919 there was a great deal of rain. I have often seen a team stall on the main street in oil towns and horses and mules down in the mud. In one instance I saw a mule down in a mudhole in front of the railroad station at Ranger.

Gum boots are very popular among men and women. In Ranger in order to cross the streets a form of sled was devised pulled by one horse. These were stationed at different corners and anyone could be set across the street for a dime.

Many mules and horses are used in the oil fields of the Southwest. The care and treatment of animals there is poor as compared with that given in northern fields. They are fed enough, but are given little thought as to shelter, grooming and bedding. What grooming the animals receive is given with a whip.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Gordon-Bennett Airplane Race

ALTHOUGH the failure of the special American racing machines to be placed in the recent Gordon-Bennett Challenge cup race in France was a keen disappointment, there are several outstanding lessons to be learned which, if laid to heart, should enable us to win, or at least come very much nearer to victory, in any future international contest.

The outstanding fact is that, as compared with the winning French machines, our own were comparatively untried, or, to borrow a yachting term, they had never been properly "tuned up." In commenting on the recent America's Cup contest, we emphasized the fact that until "Shamrock" met "Resolute," she had had no opportunity to test herself against an up-to-date racing yacht of her own type. Everyone knew that she was fast, but just how fast she would be over the Sandy Hook course against a yacht that had tuned up in American waters was not known. The American defender, on the contrary, had gone through three seasons of exhaustive trials against a yacht, the "Vanitie," which was just about as able as herself.

Similarly, when the three American machines started in the Gordon-Bennett race, they were not only flying around a circular course with which they were quite unfamiliar, but they found themselves matched against French machines that were thoroughly at home on the course and knew exactly what they could do in hugging the many turning points by resorting to steep and all-but-vertical banking. It is probable that, on a straight-away course, the American racers were faster than their French and British competitors; and had they been thoroughly well tuned up and had the course been a straight-away, we think that they would have won. But flying with the engine wide open on a straight course and flying at full power and speed around a circular course are two very different things. At a speed of approximately 170 miles an hour, it takes skill, familiarity with the turns, and absolute confidence in the strength of the wings, to make a close turn.

It is a noteworthy fact that all three of the French contestants were biplanes of a standard type, engined with standard motors. The only direction in which they departed from normal was that they carried somewhat less wing surface than the standard military machines. The winning Nieuport covered the three laps of the 300-kilometer course at a speed of 168.4 miles per hour, which is a long way below the 200 miles an hour which was freely predicted as the speed of our own and the French machines.

The three American contestants were described in our issue of September 11th. The most powerful was a Verville-Packard biplane, equipped with a 500-horse-power Liberty engine. The other two were monoplanes —a Curtiss machine equipped with a 400-horse-power engine, and a Dayton-Wright monoplane with retractable landing gear, equipped with a 250-horse-power engine. All three machines were credited with having made 200 miles an hour and over on straight-away flights. In each one, weights had been cut down to a minimum, and wing surface had been reduced to the lowest possible figure consistent with safety. None of the machines was equipped with shock absorbers in the landing gear, and all of them, because of the great engine power in proportion to wing surface, had high landing speeds.

It was these features which cost the Curtiss monoplane dearly, because when making a landing the gear, unable to stand the impact, crumpled and the machine was wrecked. The Verville-Packard biplane was put out of the race early by engine trouble, the result, it is said, of overheating due to radiator failure. The beautiful little Dayton-Wright monoplane had to come down because of failure of the steering gear, one of the rods, according to the pilot, having become bent and the machine being out of control. It is possible that, at the very high speed developed, the nascelle proved to be too short to allow of a free flow of air to the rudders, or, to put it another way, the latter did not possess sufficient area for satisfactory control. This last, however, is mere conjecture.

It should be understood that what we have said above is not at all to be considered as excuses for our failure. The flying field was a representative French flying field and the difficulties of landing and taking off were alike for all.

Einstein Contest Information

INQUIRIES about the Einstein contest having brought out several points not completely covered by the published rules, we take this opportunity to make these points clear.

The greatest concern seems to be about the precise style in which words are to be counted. Compound words, when properly used and hyphenated, will count as single words. Algebraic expressions standing for single numbers or ideas will likewise go as single words. This applies to the single letters x, y, z, t, etc., when used singly; also to such items as the functional notation $F(x, y, z, t)$ and the radical giving the value of the Einstein correction factor. Under this convention equations will count as three words—one for each member and one for the sign of equality. If mathematical notation is employed which seems to the Einstein Prize Essay Editor to fall under neither of these specifications, he will use his best judgment in applying the spirit of the convention that a word stands for an idea.

The main title will of course not figure in the word-count. But some contestants will wish to use a subtitle, sub-heads scattered through the text, etc. In view of the fact that every competing essay is a prospective contribution to the SCIENTIFIC AMERICAN, it seems proper to set our own typographical style as a standard. Sub-titles must go in on a single line of a three-column head, as seen on page 398. A sub-head may occupy no more than two lines of a single column, as seen, among other places, in our monthly articles on the Heavens; and sub-heads should average more than 500 words apart. Subject to these requirements, subtitle and sub-heads may be used and will not figure in the word count. Such fixtures when longer than thus contemplated will be counted in full, on the theory that they have been used to relieve the text of part of the story.

Many contestants will desire to illustrate their text with drawings, diagrams, etc., which may require captions. These will be regarded as part of the picture and will not be counted, unless it appears to the Einstein Editor that they have been used to relieve the text. The best way to meet this possibility is substantially to duplicate the caption in the text; but we offer this as a suggestion, not as a requirement. When the spirit of the law is violated the entire caption will be counted as part of the text.

Anything whatever in the nature of a preface or prolog, an appeal to the judges, an apology for or statement of the viewpoint of the essay, whether intended to be printed as part of the essay or not will be considered as part of it and included in the word count.

The point has been raised whether a single competitor may submit more than one essay. We know no reason why he should expect such diffusion of effort to work to his advantage, but if he does not agree with us, we shall have to allow him to submit as many essays as he pleases. We will not open the envelopes giving any name and address until after the award of the prize; so we will not be aware of multiple efforts and could not rule them out if we would. We must require, however, that when one man submits multiple essays he submit a separate identifying envelope with each, and sign a different pseudonym to each.

A few suspicious souls have asked how they can be sure that their essays reach us, since registering the package involves writing on it the name and address of the sender. Such registration is not contrary to the rules; the outer wrapper is destroyed as soon as opened, leaving no record of the sender's identity. If you do not credit us with good intentions to this extent you would best stay out of the contest.

A very delicate question has been raised by several eminent gentlemen who have already appeared in the public prints on the subject of relativity, and who wish to know whether they may use parts of their own previously appearing work in their essays. Our whole impulse is to say "yes," but there is an operating detail which almost forces us to say "no." The essays will go to Professors Page and Adams anonymously. Any material use of previously published matter will hardly escape them, for they may be assumed to be familiar with the literature. In the event that they recognize the old material, they must conclude either that the essay using it is by the original author, which would destroy its anonymity, or that the passage has been deliberately appropriated by another, which would bar the essay even if quotation marks and acknowledgment of source were employed.

It may be necessary to supplement the last paragraph with a word of reassurance. Where words are property, ideas are not. No contestant need fear to incorporate in his essay an idea which he has found in a published book or article, if he gives it new form in his own words. But direct quotation, even with acknowledgment, unless it be of a mere catch phrase, will not do.

Doubling the New York Subway System

DEARLY bought experience has shown the need for faith and foresight in providing for the future transportation requirements of large cities. This is true both of the authorities and of the public. It was the lack of clear vision and courage that so greatly delayed the commencement of the New York subways, and we are suffering the penalty of that irresolution in the present intolerable congestion of our subways. We did much better when it came to the question of doubling our facilities by the construction of the so-called Dual System; but the astonishing way in which the new lines were crowded with passengers within a few days after opening proves that, even then, we did not look far enough ahead and that we failed to perceive the accelerated rate at which subway travel was advancing.

There is nothing of timidity, however, in the bold plans for enlarging our present subway system to meet the demands of the future which the Transit Construction Commissioner has recently published. Additional trunk lines are to be built running north and south under the avenues, and these are to be associated with crosstown lines, the whole new system being located with a view to rounding out and relieving the existing system.

It is gratifying to note that on some of the proposed crosstown lines, use is to be made of the continuous moving platform. This admirable device proved its great passenger-carrying capacity as long ago as the date of the Chicago Exposition, and we believe that it will prove to be admirably adapted for a rapid distribution of the crowds which will be unloaded at certain transfer points from the north and south subways. There is no known or conceivable method of local transportation which competes with it in its flexibility and in the number of passengers that can be carried within a certain time and within certain restricted distances. The moving platform, of course, cannot compete with a fast express service; it is not intended to. But for local service it is unsurpassed, and we hope that the conservatism and lack of vision which prevented its adoption when the last addition was made to our subway service, will fail to shake the Transit Construction Commission in its determination to include one or more moving platforms in the contemplated enlargement of the system.

Forty Centuries Ago—And Now

Why Should We Not Make Paper Again from the Papyrus?

By M. Tevis

IN the present world-wide shortage of paper it is not strange that in the search for new materials some attention should be paid to the remarkable plant which was first employed for this purpose and from which paper takes its very name. The papyrus reed or *Cyperus papyrus* was first used in Egypt, for the making of paper. The Egyptians in fact made many uses of this remarkable plant growing in the shallow waters of the Nile. The main root of the plant, which is about as thick as a man's wrist, lies in a horizontal position, while smaller roots extend downward from it into the mud and the stem rises into the air. These stems are triangular and tapering in shape and bear a picturesque tuft or umbel at the top which was compared by Pliny to a thyrsus, the crowned and garlanded staff borne by devotees of Bacchus in their revels.

This tufted head was used for the making of garlands wherewith to crown the images of the gods and wreathe their shrines. The root was used to make various utensils as well as for fuel. The pith contained in the stem was a common article of food both raw and cooked. The great value of the plant, however, lay in the stem; this is commonly six to ten feet long and a recent British investigator declares that along the upper Nile, where the plant still grows, though it is now extinct along the lower Nile, the stems often exceed fifteen feet in length. From this stem not only writing material was made but also cord, rope, and cloth, mats, sails, and boats. A certain piece of sculpture has been found belonging to the fourth dynasty, in which men are shown building a light skiff with stems cut from a neighboring plantation of papyrus. Some authorities indeed believe that the bulrushes mentioned in the Bible were really papyrus plants.

For the purpose of making paper the triangular stem was cut into longitudinal strips, those from the center of the plant being the broadest and most valuable. These strips were placed side by side on a board, forming a layer of suitable width, which was then covered with another layer of shorter strips laid at right angles. The sheet thus formed was soaked in the waters of the Nile, which caused the two layers to adhere firmly to each other, probably from deliberation of some sort of glutinous matter in the substance of the stem itself. The sheet was then pressed and dried in the sun, afterwards being polished with oil of cedar by means of ivory or a smooth shell. To form a roll the sheets were joined together with paste (glue being too hard).

The use of papyrus spread from Egypt to Greece and Italy and thence over Europe; it was finally superseded by vellum but did not entirely disappear until about the twelfth century.

Of recent years the papyrus plant has been freshly studied by English, French, and German authorities. In a late report made by certain British investigators it is stated that for a distance of three hundred miles along the upper Nile, it is at times exceedingly difficult to keep the main channel clear because of the enormous quantities of papyrus and other water plants which choke it, while all the tributary streams in this region are blocked for many miles. This dense vegetation is known by the general name of "sudd," and experienced observers estimate that it covers not less than 5,000 square miles, forming an immense store of valuable material either for fuel or for other purposes. It is estimated, indeed, that there is a store of 144,000,000 tons of sudd in this area. Employed as fuel this would be equal to 28,000,000 tons of coal and would be capable of yielding an amount of horsepower equal to about three-fourths of the theoretical average power of Niagara Falls.

But this material is also capable of yielding rope fiber and paper pulp, while the ash contains so much potash as to form a valuable fertilizer. Crude paper pulp, known in the trade as "half stuff" is readily obtainable, according to experiments made by an English chemist, by heating the papyrus stem either green or dry under pressure, to about 150 degrees Centigrade with water alone, no caustic soda or other chemicals being required. The air-dried papyrus yields about forty per cent of dry "half stuff" and about twenty per cent of dried bleached pulp. The paper made from this pulp is of very fine quality. Still more recent research at the laboratory in Khartoum shows that papyrus stems, when treated with hot water, under a pressure of about four atmospheres, yield practically all their mineral matter and most of the protein to the solution, while the residue constitutes very satisfactory crude paper pulp.

According to French students of the same subject papyrus pulp is very fine, slightly resembling that made from alfalfa. The fibers of the papyrus are regular and cylindrical and very fine and short, having tapering ends and a central canal one-third the width of the fibers. There are immense fields of papyrus in the French colonies of West Africa, especially in the delta of the Congo, and it is believed that when there are sufficient facilities in the way of railroads and labor, this material will be drawn on heavily.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Saving Wear on Shoe Soles

To the Editor of the SCIENTIFIC AMERICAN:

I note in your issue of July 31 last an article relative to a process for saving wear on shoe soles. I think I can go the writer one better by suggesting that copal or dark varnish be used in place of vaseline or oil. Apply as many coats as soles will soak in. Have found that this will make the soles outwear the uppers.

Old Mystic Ct. W. H. F. HANKS.

The Horizontal Rainbow

To the Editor of the SCIENTIFIC AMERICAN:

I recently noticed a phenomenon of light while flying for which I do not derive a satisfactory explanation. I will be pleased to learn the proper explanation from yourself or from a reader of the SCIENTIFIC AMERICAN.

The phenomenon consisted of a rainbow in the form of an ellipse, a rather elongated ellipse. It occurred while I was flying around a small rainstorm and showed up on a low hanging mass of rain and water vapor some two thousand feet below me; it, of course, moved as I moved in the plane, and remained very bright for some two or three minutes. To give the details of the light direction I will mention that it occurred in the latter part of June about three o'clock in the afternoon in the latitude of Houston, Texas. I was flying in an easterly direction and the major axis of the ellipse seemed to lie in a line pointing a few degrees east of north, the ellipse lying to the north of my path, and as nearly as I was able to estimate it the shadow of my plane fell on what would be the southern focus, i. e., the focus nearest the plane, the red end of the spectrum being on the inside.

I trust that this may be of interest to some of your readers and thank you in advance for any light which you or they may be able to throw upon the phenomena.

RUFUS RIDDLESBARGER.

[This is a case of the horizontal rainbow, formed by a more or less horizontal sheet of water drops below the level of the observer's eye. Such bows are seen upon a layer of cloud from a mountain summit or from aircraft, but those that have heretofore been observed and discussed in detail have generally been seen over bedewed fields or a thin sheet of fog near the ground or water, or in droplets deposited on a layer of oil floating on the water. The horizontal bow is circular only when the sun is overhead; at other solar altitudes it is elliptical, parabolic or hyperbolic. This feature is well explained with a diagram by Dr. Otto Klotz in the Journal of the Royal Astronomical Society of Canada, September, 1917, p. 294 ffg. Another explanation appears in Nature, March 1, 1916, p. 5. A résumé of several observations of horizontal rainbows appears in the Monthly Weather Review (Washington, D. C.), Feb., 1916, p. 65.—THE EDITOR.]

Protecting Trees from the Sun

To the Editor of the SCIENTIFIC AMERICAN:

In a recent issue I noted the article regarding the desirability of protecting trees when transplanted from the effects of the hot sun. This has been known and the practise of protection systematized here, the common usage being either to loosely wrap the young trunk with a heavy grade of wood veneer tied with wire, or to nail a couple of six-inch boards into a V-shape and to drive these down a couple of inches from the tree so as to permit of ventilation while protecting the bark from the southwest sun. These schemes are both inexpensive, easily applied and readily removed when the tree is established.

St. Louis. A. BLAIR RIDINGTON.

Metering Liquids

To the Editor of the SCIENTIFIC AMERICAN:

In a recent issue you carried a description of a "device for measuring the flow of liquids," stating that this was put out by an English firm. This description appears to be of an instrument which has been manufactured for the past ten years by my firm, and which has found wide application not only in the field of water measurement, but in the chemical industries and in the manufacture of paper as well. I hope you will agree with me that in fairness to our company you ought to make this clear to your readers.

Philadelphia. L. G. CHASE.

Saving Gas

To the Editor of the SCIENTIFIC AMERICAN:

Your timely editorial, "How Many Miles to the Gallon?" in your issue of September 4th, if answered by many drivers who are making good mileage, telling how they do it, might lead to economizing results both in driving and in making autos. I have been trying out an idea, not a new one by any means, and the result has convinced me that at least one kind of carburetor is wasteful of gasoline, and also that there should be an authoritative test of all carburetors, and all condemned that do not come up to a certain standard. The idea referred to is the admission of air to the manifold for which purpose I use a quarter-inch pet-cock with a rod connected to same and extending through dash, giving control of amount of air admitted from driver's seat. My car when running on the leanest practicable mixture with pet-cock closed, will reach its greatest speed with cock about half open, but for runs of any distance I enrich the mixture a trifle and keep the cock wide open, and am making 30 miles to the gallon—short runs excluded—over country roads and about half of them sandy; more than 50 per cent better than I could do before. On rough country roads and city streets the cock is kept closed; with it wide open the engine will not work well when running slow.

The gas pressure in the manifold of an engine running at fair speed is much below atmospheric pressure resulting in a suction on the carburetor intake which effects the feed. When the engine slows down that suction and the inflow of gas are decreased to the point where, when mixed with the inflowing air from the pet-cock it becomes too lean to fire properly.

The increased power I get is probably due both to better evaporation and to the expansion of the air heated in the cylinders by the burning gas, and that leads to the idea that some day air may be used in gas engines to a much larger extent than at present. The air may be admitted and compressed in the cylinders as the gas is now and the burning gas admitted at the moment of ignition from a separate chamber. And then there is dust many kinds of which under right conditions are powerful explosives, and such conditions should not be difficult to provide in gas engines.

I witnessed the results of the flour mill explosion in Minneapolis in 1878, and since have had considerable respect for the potentialities of dust.

Caldwall, Ida. H. W. STONE.

To Einstein Prize Essayists

To the Editor of the SCIENTIFIC AMERICAN:

I have in my possession a type-written lecture of recent date given by a German scientist on Einstein's principle of relativity. The lecture is supposed to be a popular one, although it is not free from mathematical formulas. It was held before a group of technical engineers in one of Germany's largest industrial plants. I am willing to loan it to any of the competitors for the Einstein prize essay who is able to understand German, on condition, of course, that the lecture be returned to me in due time.

Bowman, N. D. CHAS. BACHER.

Concrete and the Building Crisis

Some of the Advantages Which Have Led to Wide Adoption of This Structural Type

By Robert G. Skerrett

STRUCTURAL concrete bids fair to be our industrial salvation in the erection of loft, office, and factory buildings. The housing situation for many of our indispensable activities has reached an acute stage, and we are likely to be hampered for some years to come unless we can provide quickly and at a reasonable cost proper accommodations for our business, our productive, and our administrative enterprises of various kinds.

Building materials of more familiar kinds are high priced and difficult to get with any dispatch, deliveries being more or less uncertain; and skilled labor of all classes is exceedingly expensive and likewise hard to obtain. Nevertheless, no one wants to put his money in a building that falls in any way short of accepted structural standards. Happily, there is a solution for the problem.

Reinforced concrete no longer involves physical uncertainties. The technique of mixing has been reduced to definite formulæ suitable to divers needs. The qualified builder knows today that he must make certain that neither his aggregates nor his sands contain injurious vegetable or other organic matter, and tests are prescribed which enable him to determine this. In the same manner he understands that he should use water that is clean and free from oil, acid, alkali, or vegetable substances. He has learned that the measure of water in the mix bears directly upon the ultimate strength of the concrete and also determines the time that must elapse before his molds may be removed. Finally, experience has taught him that his reinforcing metal should subscribe to standard specifications and be free from excessive rust, scale, paint, or coatings of any character which might tend to reduce or to destroy the bond between the steel and the enveloping concrete.

Failure to adhere to these requirements by people who have rushed into the field of concrete construction without proper training explains the disappointing results that have occurred from time to time. Today the established companies engaged in this branch of engineering go forward with the same confidence that would follow the use of other materials.

In a number of our populous centers it is essential that there be reared as quickly as possible some scores of buildings of the loft type, ranging anywhere from six to twelve stories in height, in order that the most can be made of the ground area available; and an analysis of existing conditions in the labor and material markets reveals that these demands cannot be met speedily unless concrete be employed.

An office building that brings out the artistic possibilities of concrete

This huge structure, 200x331 feet, covering an entire square, is representative of the best concrete factory design

Two concrete buildings of different types now going up in New York

THE expansion of industry and the concentration of business enterprises in our centers of population have brought about a real crisis. Structural materials and skilled labor are hard to obtain in sufficient quantities to rear the buildings that are sorely needed. In this situation reinforced concrete bids fair to provide an ample and a ready relief. The reasons for this are broadly covered in the accompanying article, but emphasis is given this presentation by an analysis of costs of the structural frame for a 10-story loft building, in different types of construction:

All reinforced concrete, $1.50 per square foot.

Reinforced concrete except that steel cores are used in both exterior and interior columns, $1.90 per square foot.

Structural steel with terra cotta or cinder-concrete floor arches, $2.50 per square foot.

Contrary to the belief entertained by the uninformed, the adoption of concrete does not entail dampness, difficulty of making changes, or any uncertainty as to safety.—THE EDITOR.

The strength of a concrete structure is largely dependent upon the disposition and the dimensions of the supporting columns. In buildings up to twelve stories in height, a suitable concrete column of circular section to do the work of a 20-inch-square steel column would have a diameter of approximately 34 inches; such a concrete column might be properly designed to carry a live load of 150 pounds. Of course, there are at times objections to surrendering so much floor space to the larger cylindrical concrete columns, but this difficulty can be offset by substituting on the lower floors smaller concrete columns strengthened by cores of either steel or cast iron. Naturally, as each added story is reached the weight to be borne diminishes, and all-concrete columns of lesser diameters answer on the upper floors. A concrete skeleton building, even when having steel or iron-cored columns, will cost considerably less than a steel structure of like proportions. The adoption of the more expensive columns would hinge, of course, upon the rental value of the floor space saved.

The thickness of concrete floors for a specified load varies according to the distance between the columns. In order to obtain the needful girder strength, the floor thickness is greatest where the span between the columns is longest; and the factor of safety commonly allowed by competent designers has proved on many occasions equal to a much greater burden. For instance, floors of the girder-beam-and-slab type, intended for a load of 200 pounds to the square foot, were found capable of holding up under an average weight of 900 pounds; and another floor of the flat slab type, for which the prescribed load was also 200 pounds, did not fail when the burden reached more than 1,200 pounds. Concrete girders having a 50-foot span are carrying right along floor loads of 500 pounds to the square foot.

The monolithic character of reinforced concrete buildings admirably adapts them to resist the vibration which might otherwise be set up by rapidly moving machinery; so mechanical equipment can be held rigidly to the floors and run at higher speeds. Factory work can thus be permitted in structures where the other tenants might be seriously disturbed if vibration existed.

In Greater New York, nearly every loft and office building has granolithic concrete floors. Those that are not so fitted have wood floors; there is no structural or economic difficulty involved in this detail, the choice being determined mainly by willingness to pay the difference in cost. For the sake of finish, some owners prefer brick curtain walls, but this often involves a sacrifice of floor space. An 8-inch concrete wall is claimed to be as tight as, if not tighter than, a 12-inch brick wall; and there is rarely any trouble with concrete walls even though they have not been waterproofed in any way.

The reinforced concrete structure of the loft type saves money inasmuch as the interior walls and ceilings need no plastering except in the entrance halls, etc., where a certain meas-

The early appearance of the huge concrete building of an electric company in New York, showing the emplacement of column molds and the work of laying concrete and erecting forms on the ground floor

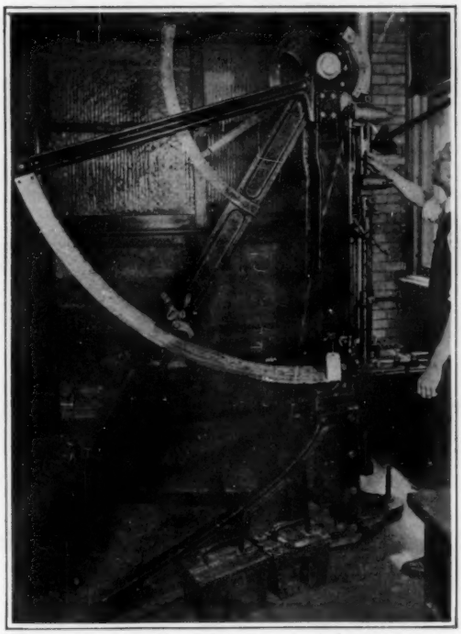
ure of decoration is desirable. The adaptability of the concrete loft structure is well brought out where it is reared adjacent to old buildings. In such circumstances it is possible to place the wall columns from four to six feet inside the external lines, carrying the exterior walls on cantilevered floors. On narrow city lots this characteristic might prove a highly important factor.

As time is of the essence of the present situation, the speed at which concrete buildings can be erected is of moment. On the average, from the time decision is made to start work a concrete building can usually be completed at least as quickly as a typical steel structure of the same dimensions. And carefully prepared detail estimates show in numerous cases a saving of 40 per cent over steel where structural concrete framing is employed; while the total saving on the completed and outfitted structure often averages quite 20 per cent. All this is well illustrated by a building now going up in New York City and covering an area of 331 x 200 feet.

A ground plan of such magnitude, filling in fact, a whole square, requires the movement, distribution and emplacement of large quantities of materials during the various stages of construction. Reinforced concrete will be used throughout with the exception of a brick veneer on the exterior walls. Here we have striking evidence of the benefits of mechanical equipment for the handling of essential materials. To begin with, there are centrally located in the basement two power-driven mixers placed directly beneath the towers of two gravity plants for the delivery of concrete anywhere within the building area. The sand and gravel are dumped at one side of the site from the street level into a bin from which the premixed stuff is carried by a belt conveyor to the middle of the cellar and there transferred to two smaller conveyors running at right angles. These drop the aggregate into bins close by and the latter feed directly into the power mixers. Attached to each bin is a hopper of a prescribed capacity, and the attendant worker has only to raise a vertical sliding door to release the desired amount of the sand and gravel. Similarly, from the adjacent platform, just enough cement and water are measured and dumped into the mixer to make up a cubic yard of concrete. The mixer delivers the concrete to a hoist bucket, and every minute it is possible to raise a load to the desired height, dump it into the tower hopper, and send it by gravity down the line of chutes to any point between the base of the tower and outward within an operative radius of 160 feet. In this way, the two towers can handle two cubic yards every 60 seconds. No trouble is experienced in thus placing, during a working day, quite 700 cubic yards of concrete.

The counterweight chutes, supported by steel booms, permit the utmost flexibility. The distributing system does not clutter up the floor in any manner. There are no trestles or runways to interfere with workers engaged in other parts of the undertaking. The concrete can be delivered as fast as the mixer can prepare it and as soon as the forms are ready to receive it. The equipment saves in unit labor costs because the hoisting engine and gravity take the place of the men otherwise required to wheel the concrete from the point of mixing to those of deposit. The amazing feature about up-to-date work of this sort is the many things of various kinds that can be done simultaneously without causing confusion. A little analysis reveals that this would not be possible but for the mechanical facilities employed in mixing and in distributing

(*Continued on page 409*)



The arrow at the upper right shows where the strap is inserted in the machine. Note that the one here being tested has just parted

Measuring the strength of a leather strap

Testing Ropes and Straps

HOW strong are the stirrup straps used on your favorite riding horse? Are the traces used in pulling farm machinery equal to the task? And, figuratively speaking, is the rope strong enough to hang a man? Such questions can be answered by a machine perfected by the Bureau of Chemistry, United States Department of Agriculture, which is capable of testing the tensile strength of fabrics, textiles and harness leather.

For instance, if you wish to know the strength of the belt you wear on your clothes, put in motion the one-and-one-half horse-power motor in the laboratory of the Bureau, thus starting the tensile machine. Different weights are applied to the pulling lever, the apparatus operating from a pivot near the top along graduating scales, one of which automatically records the pulling power necessary to break a given piece of textile, fabric or harness leather. Our illustration shows the general ensemble of the machine, and suggests quite clearly the manner in which the leverage necessary for the test is brought to bear in increasing measure until failure occurs.

The object under test is gradually given all the load it will bear, the machine automatically registering the stretching strength of the object up to the breaking point. The apparatus is not only valuable for determining faulty textiles, fabrics and harness leather, but the data can be applied in drawing up specifications in manufacturing material of substantial tensile strength. It is said to be the largest machine of this character in use.—By *S. R. Winters.*

Piling Up the River Bottom Into a Dike

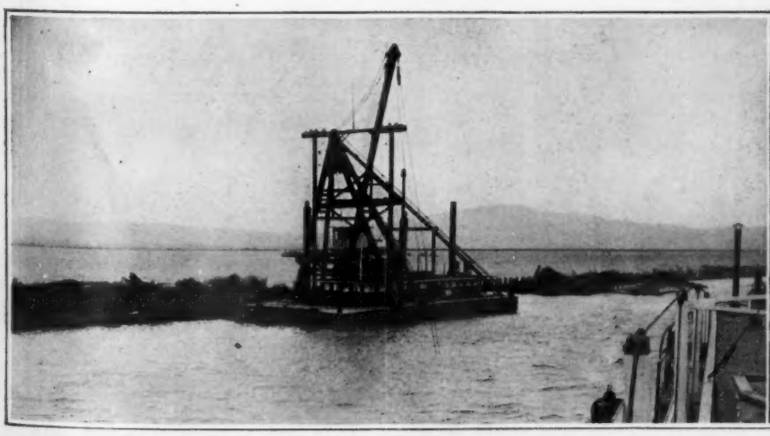
MARK TWAIN, in one of his most amusing veins, described the disease which might be named Mississippitis. It consisted in a violent attack of emotional insanity in connection with one or another of the projects afoot for the improvement of the valley of this great stream. But the peculiar part of the thing was that it never affected any two people exactly the same. Where one maniac would range over the country in the cause of dredging a channel of ridiculous depth from the Twin Cities to the Gulf, another advocated with equal ardor the filling of the river so as to make the water scour out its own navigable pathway. Where a third enthusiast was booming the construction of vast works to prevent floods, another was distributing propaganda looking toward the expenditure of millions of dollars for large reservoirs in the upper parts of the Mississippi drainage basin to prevent the recurrence of low water.

The great humorist does not tell us so explicitly, but it is a fact that he could depict such a variation of opinion as to what ought to be done to the Mississippi, merely because the problem presented by the river does actually vary most widely from season to season and from year to year. It does carry its flood levels to destructive heights, and it does go down, in its dry season, to a point that is destructive to interests that depend upon a reasonably full river. It does call for treatment of the most divergent character, and does confront the engineer with directly contradictory requirement. And while a good many of its vagaries have been successfully dealt with, some remain.

But today the Mississippi is not alone in puzzling the engineer through the apparently irreconcilable nature of the problems that it presents. California has a river—the Sacramento—that goes to equally violent extremes, and calls for equally contradictory measures in its control. And here there is an additional complication not present on the Mississippi. The State of California is interested, more than anything else, in the volume of irrigation water that it can get out of the river. But the Federal Government steps in to say that the river is a navigable stream, and must be treated and conserved as such. Accordingly the engineers must so handle the river that there shall be enough water for the irrigationists, and enough left over after they are through with the stream to float the ships which carry their products to the markets.

The whole problem really resolves itself into one of flood control. When this is properly handled, the subsidiary problems of irrigation and navigation will have been resolved. And, as our photographs show, the control of the spring flood waters is being undertaken in a rather novel way.

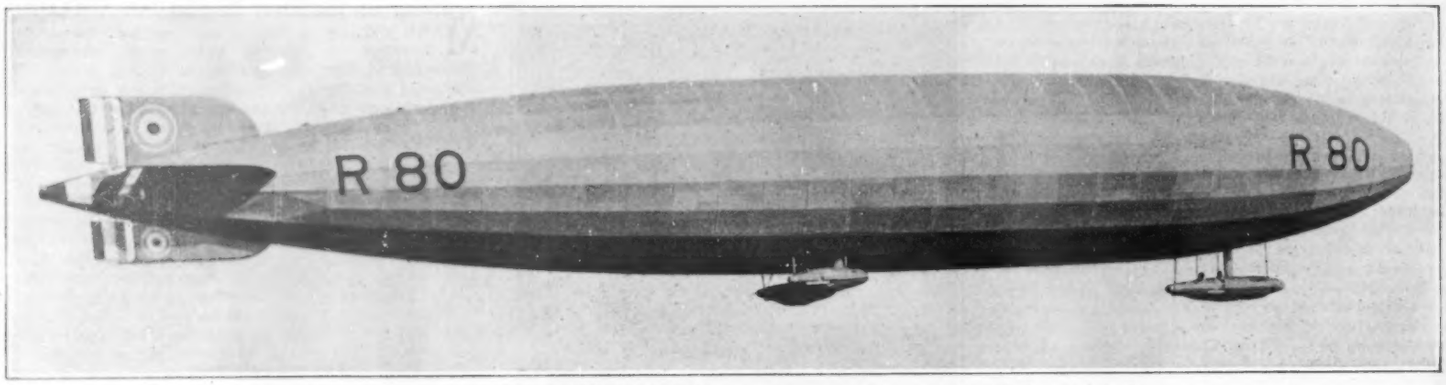
The problem centers in the so-called delta—a region of flats under low water, which has been built up by the deposits from the periodical floods of the centuries. The treatment consists in diking—but the distinctive feature is the manner in which this diking is carried out. It happens that the material from the bottom of the river in this section is sufficiently heavy and water-resistive to make satisfactory dikes; so the process is simply to turn a big dredge loose, piling up the bottom of the flat into a high ridge. At one stroke the waterway is deepened, and enclosed within a confining dike that protects the surrounding territory from reinundation. Our pictures show work of this sort in progress, and a scene where it has been finished, so that the greatly narrowed and deepened stream flows along with its surface well above the level of the surrounding country behind the dike.



Dredger building up a levee between river and flooded bottoms

Where the river walks on stilts, high above the fields

The process of deepening the Sacramento River which results in banking it up in an artificial channel, well above the level of the surrounding country



General view of the British rigid dirigible R-80 after the successful completion of the trial flight

The Aerial Cruiser

Some Details Concerning the Latest British Rigid Dirigible R-80

SOME twelve months after the notable trip of airship R-34 from England to America and back, a smaller edition of that ship, R-80, which embodies many improvements, had a successful trial flight. We present several views of this ship, and there follows a description of its construction and a comparison with the earlier and larger R-34.

At the time the ship was taken out for its first trial, the wind was blowing with a velocity of fifteen knots. The flight, which was carried out over the sea, lasted about two hours, and a landing was safely effected in a wind of about seventeen knots. Both in leaving the ground and in its return to the shed, R-80 was handled with facility and the trials were an unqualified success.

By way of comparison we give the accompanying table comparing R-80 and R-33.

Construction

The main transverse frames are placed between the gasbag ends, with intermediate members. All the framework girders are of triangular cross section. Transverse wiring at the main frames transmits the lift of the gas to the keel girder and maintains the shape of the transverse section. A longitudinal stay connects the transverse wiring at each main frame. The main diagonal bracing wires are of three series—major, minor, and mesh wiring; the first two on the external surface of the ship. The mesh wiring on the inner surface of the girders transmits the gasbag lifting pressure to the framework. The triangular keel girder has its base formed by the lowest flat of the transverse frame polygon. This keel contains the cabin, bombs, petrol, water ballast, etc., and is sufficiently strong to transmit all loading, including the weight of the cars, into the main structure. There is a walking way the entire length of the keel girder, with branches to the wing cars, providing thoroughly sheltered communication.

The total gas space is divided into fifteen compartments, each containing one gasbag. The outer cover is formed with a number of separate panels laced to the girder, the joint space being covered with a sealing strip.

A novel feature is a walking way and hand line which run along the top of the hull. There is a gun platform forward, and ventilation shafts are placed between each pair of gasbags.

The Four Cars

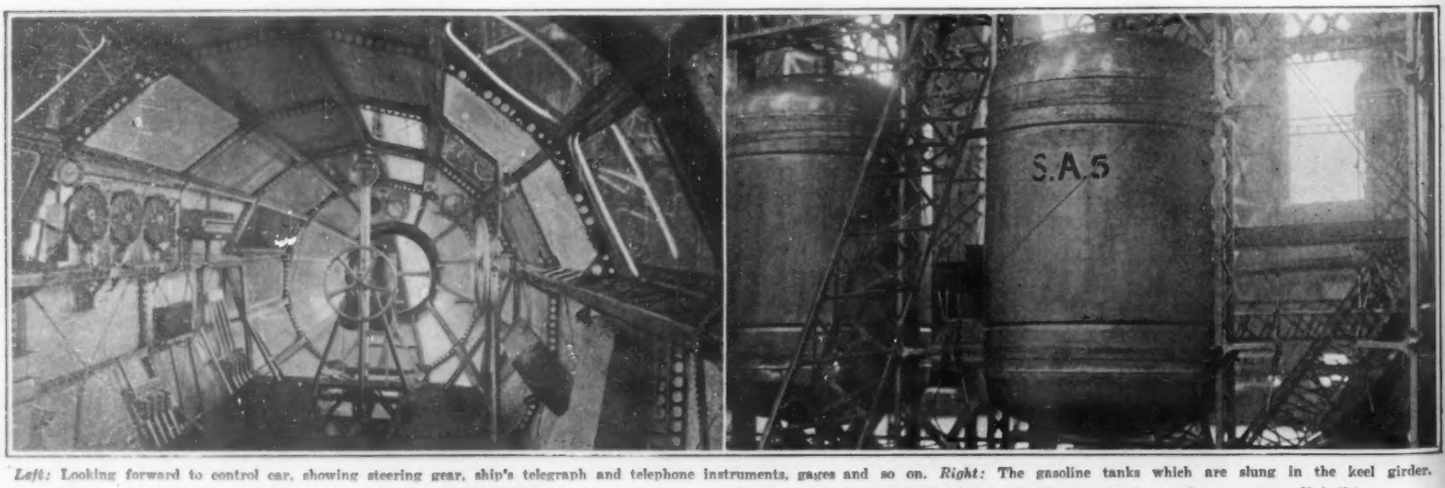
There are four cars suspended from the hull, the two forward ones being placed one behind the other and joined flexibly together to form one streamline shape. The forward half is the control portion, and in it are found the navigating controls and instruments and the wireless cabin; in the after portion there are two sets of engines. The two separate wing cars are suspended on each side of the keel and each contains one set of engines. Particular attention has been given to the elimination of head resistance and the cars, which are built of duralumin, have a perfect streamline form. Opening windows of triplex glass are fitted where required, and in positions of less importance there are windows of non-inflammable celluloid.

Below every car is attached a special inflated buffer bag; these bags have sufficient buoyancy to enable the ship to alight and float safely on the water, and they also make an effective cushion when landing on the ground. The controls from the forward car are conducted up through the trunk, which leads from the car to the ship, and then they are taken forward or aft through the interior keel. There are large luminous indicators in the control car, which show the degrees of helm and of elevation. All the gas valves are operated from the

(*Continued on page 409*)

The R-80 and R-33 at a Glance

Particulars	*R-80*	*R-33*
Gross displacement (tons)	38.25	60.0
Gross disposable lift (tons)	17.80	26.75
Minimum weight of crew, stores, and ballast required for prolonged flight (tons)	3.8	5.0
Residual disposable lift available for fuel and oil (tons)	13.7	21.75
Speed at full power, m.p.h.	65.0	65.0
Speed at cruising power, m.p.h.	50.0	50.0
Total b.h.p. at full power	1,000	1,500
Range in miles—full power	3,900	3,600
Range in miles—cruising power	6,400	6,000
Endurance in hours—full power	60	56
Maximum height attainable as free balloon (feet)	19,500	18,000
Maximum height attainable with crew and stores for prolonged flight	17,000	16,000



Left: Looking forward to control car, showing steering gear, ship's telegraph and telephone instruments, gages and so on. *Right:* The gasoline tanks which are slung in the keel girder.

Two views aboard the R-80, showing how the British constructors are gradually refining their airships with the appearance of every new dirigible

What Are Great Britain's Mystery Towers?

IN a previous issue we printed an account of the two "mystery ships" then building for the British Admiralty. Their strange appearance and the air of mystery surrounding their construction and their use aroused great comment at the time.

Constructed on a sandy foreshore at Southwick, an obscure village between Storeham and Brighton on the Channel Coast, the two "mystery ships" have long been objects of interest. In shape they are not unlike a huge wedding cake, consisting of three tiers of hollow concrete blocks, surmounted by a tall wide tower, not unlike a gas-holder. The total height of each ship is almost 200 feet. Their method of construction is highly ingenious. The bottom story, consisting, as has been said, of hollow concrete blocks, rests on the foreshore; the tides play about it, and the long months during which it has lain on the beach have covered it with seaweed and barnacles. Powerful pumps are installed in the lower tier so that it may be pumped dry at will. Sluice gates are also fitted to enable it to be flooded and sunk. Until Sunday morning, September 12th, this lower tier was full of water, the weight of this serving to ballast the whole structure which towered above.

Early in the morning, at low tide, however, the sluice gates were opened and muddy water poured from the openings of the lower tier. As the tide rose the sluices were closed and the pumps were set to work. Within a short time they had lowered the water level in the hollow concrete by a further four feet.

Meanwhile the tower had been attached by hawsers to two lighters. As the tide rose—an exceptionally high spring tide for which the engineers had waited some weeks—the tower, now lightened of its ballast, rose too. Its ungainly bulk was trimmed until it floated upright—its upper deck some 200 feet above the crowd of spectators. The "launch" was accomplished slowly and without fuss. There was no excitement of greasy slipways and quick spectacular glissade.

As soon as the tower had floated, a flotilla of Portsmouth Dockyard tugs stood by to tow it. The task was not easy. A specially dredged channel had been prepared; the draught of the tower is such that the clearance in some parts of the channel is measured in inches. Seven tugs were used in the towage. It was necessary to guide the huge bulk between wooden piers. Notwithstanding repeated warnings, these were lined with interested spectators, and a chance tilt against the piers would have seriously damaged both the tower and the pier, with probable loss of life.

The tricky passage was negotiated with only one unimportant mishap, and as soon as the tower was clear it was seized by additional tugs and slowly made its way by open sea (which was exceptionally calm) toward Spithead. It is thought that its destination is the Solent, but official quarters are reticent on this point.

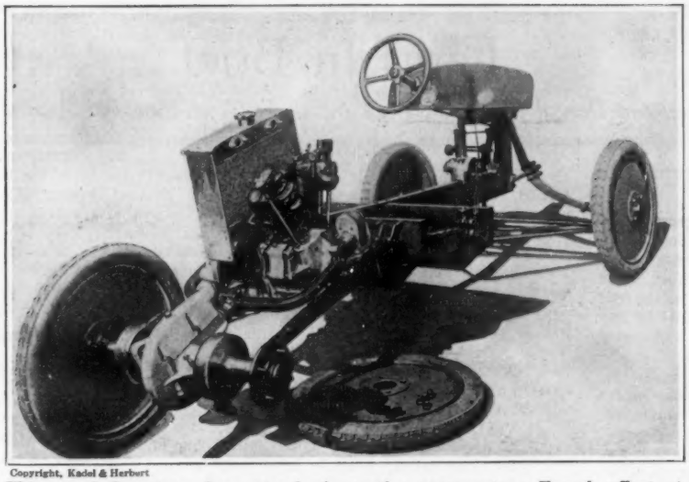
Its companion tower is scarcely completed and conditions will not be suitable for its "launch" until the high tides of March next.

The whole of the arrangements for the building and launch of the tower have been under the charge of Capt Cliffe of the Royal Marine Engineers.

Speculation is still rife concerning the probable use of these mystery towers. One of the many theories advanced is that they will be used for raising the shipping sunk during the war by the German submarine campaign. By means of these towers, it is suggested, sunken vessels lying in water too deep or too rough for ordinary salvage could be raised. By "dragging," hawsers might be passed underneath the sunken vessel. The towers would be sunk, one on either side, and the hawsers made fast. The two towers (which may be submerged to a depth of 180 feet) would be simultaneously pumped empty of water, thus raising the vessel. The whole flotilla, with the vessel cradled between the two towers, coulb then be towed away to shallow water, where the vessel could be beached. By repeating this process it would be possible to salve vessels now lying far too deep for recovery. Such is the theory.

Another suggestion is that had not the armistice intervened in November, 1918, some five or six of these towers would have been sunk in the Straits of Dover, made tight on the seabed with concrete grouted in, and pumped clear of water. The gigantic caissons so formed would have enabled work on the Channel Tunnel to be carried out with great rapidity. By sinking shafts in the interior of each tower, and driving headers in each direction from its foot, a dozen working faces would have been secured; whereas if the tunnel were to be driven from each end in the usual way, two only would be available.

Further suggestions are that the towers are destined to serve as protective underwater fortresses for the Naval Harbor at Portsmout—a contention which gains ground when it is remembered that the first tower has been towed to the Spithead.—By *F. Rawlinson.*



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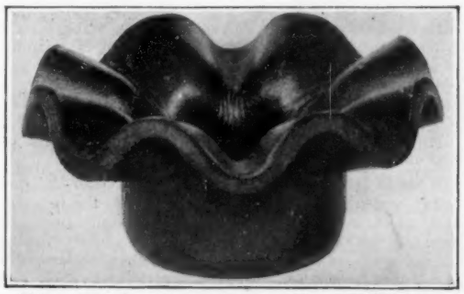
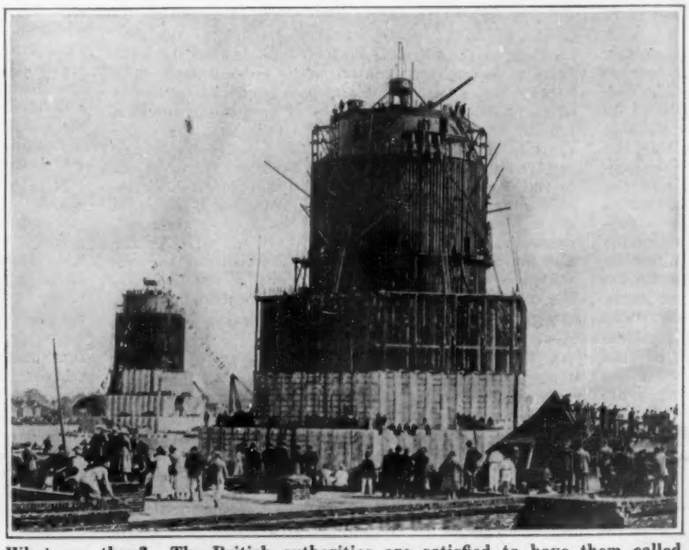
This novel departure from standard practice represents a French effort at producing an inexpensive automobile



This queer-shaped cup was recently moulded from a piece of leather over four hundred years old



What are they? The British authorities are satisfied to have them called "Mystery Towers," but will say nothing regarding their purpose

Reducing the Automobile to Its Essentials

FROM France comes the latest idea in automobile designs, namely, the frameless car. Indeed, here is a design which calls for an automobile that is practically all power and wheels, so to speak, with the usual parasitic elements reduced to the irreducible minimum.

A study of the accompanying view of one of the new cars tells the entire story. It will be noted that the usual frame construction is done away with, and in its stead we have little more than springs. The engine, which is a two-cylinder affair, is placed at the rear, so that this chassis is obviously intended for a two-passenger car. The radiator is placed sideways, as shown. The rear axle, it will be noted, is mounted on a pair of springs and held by a U-shaped member whose legs terminate in pivots on either side of the power plant, the latter being mounted on the center of the springs. All in all, this construction is exceedingly novel and ingenious, although it seems quite obvious that it can only be applied to the lightest kind of passenger cars. But for these it will surely economize fuel!

There is Nothing Like Leather

THE leather cup which we illustrate is a striking proof of the durability of good leather, for it is at least four hundred years old. Proof of its age is found in the following facts. At some time prior to 1893 there was standing in the city of Hamburg, Germany, an old building which had to be removed to make way for improvements. Records and tradition established the fact that this building had been standing four hundred years. There is nothing very remarkable about that; but when the building had been torn down and the foundations for the new building were being dug, the workmen discovered some old tan vats, which were evidenty the remains of an old tannery that had been in operation on this site before this four-hundred-year-old building was put up. In one of the vats, which probably had been filled in with earth, they found a relic of the old tannery in the shape of a tanned hide. Part of this hide fell into the hands of a prominent merchant in Hamburg, who dealt in leather goods. He was sufficiently interested in the relic to have molded from a piece of the hide a leather cup, which he brought with him to America in 1893, at the time of the Chicago Exposition, and he left this cup with one of the largest of our leather manufacturers, who vouch for the integrity and standing of Mr. Gearckens, the donor of the cup. In consideration of its great age, it is a tribute to the quality of this ancient piece of leather that it could be molded into such a shape as this. We are informed that only a very high-class piece of leather would stand, without breaking, the pressure required to complete the right-angled bend at the bottom of the cup, as shown in the illustration. The forming of the fluting at the top of the cup was a strain upon the leather only a little less severe. Yet the leather has been bent and molded both in these convolutions and in the body of the cup itself without showing any cracks.

The *Bulletin* of the National Association of Leather Belting Manufacturers, in speaking of this interesting experiment, reminds us that the enduring life of good leather is due to the fact that it does not corrode or oxidize or disintegrate, and as this piece proves, will retain its life for centuries.

Paper on a Specification Basis

RECENTLY a marked increase in the use of paper bags as containers for lime and cement was noted. Uncle Sam in his paper conservation campaign is investigating the various materials suitable for such purposes. He has devised an invaluable test machine which shows definitely the stress, strain value of the paper as well as the stretch which results under load. He now is perfecting a testing apparatus which will reproduce under laboratory conditions the strain on the bag when it is dropped. The idea of the government experts is to so correlate these tests that the actual service conditions to which bags are exposed may be reproduced in the testing laboratory.

Items In Brief

A Department Devoted to Current News in All Fields of Pure and Applied Science

Electrical

X-Rays and the Shoe.—A leading New York store has recently installed an ingenious X-ray outfit which permits its patrons to see just how their feet fit in any pair of shoes. In fact, at a glance the patrons can note the position of the bones of their feet in any given pair of shoes, and in that manner determine whether they are trying the proper last or not.

Radio Control for Airplanes.—There can be no doubt that if the war had lasted a few months longer we would have witnessed the leading armies employing great fleets of airplanes controlled by radio means. The United State Army had progressed pretty far along this line when the armistice was declared. The same can be said for Germany. Now we learn that the French have demonstrated that five or six small and inexpensive bombing planes, without pilot, can be successfully guided by a "shepherd" in a larger plane through the means of Hertzian waves.

Glass Insulators for High Voltages.—Tests with glass insulators have been in progress in Switzerland for several years, and numbers of these insulators have been used in France and the United States, for potentials up to 50,000 volts. The principal application for glass insulators is, however, up to 25,000 volts. Such failures as have occurred with glass insulators have been due principally to internal stresses which cause cracking when the insulator is subjected to heavy mechanical stress or sudden temperature change. The occurrence of such failures has been made less frequent by the use of improved material and better annealing. As for the puncture strength, it is higher than that of glazed hard porcelain. The glass used in Switzerland is clear and transparent, hence the absorption of solar heat is less than in the dark green glass hitherto employed.

High-Power Arc Lamp.—In the Garbarini rotating arc lamp the inventor aims at (1) a single light-source of small area and great brightness; (2) the integral utilization of the light from a source; and (3) the automatic maintenance of the point-source in its correct optical position. A horizontal, cored positive electrode is used forming a small central crater. The negative is of metal, cooled by circulating water or gasoline, and is non-luminous. It is annular in shape, and terminated by a ring-edge; the crater of the positive is situated at the center of the annulus. The arc formed between the annulus-edge and the unobstructed positive crater would tend to wander and become unstable. Accordingly a solenoid is mounted with the positive electrode as axis, and the magnetic field thus produced causes the arc to revolve at 500 to 3,000 r.p.m. At this speed the motion is not detected by the eye, which merely sees the central bright spot, the crater, surrounded by a slightly luminous haze. Such an arc has, in effect, uniform length and resistance and gives a constant light.

New Tank for Transformers.—A leading electric company is developing the use of a so-called conservator in connection with oil-filled transformers. The conservator consists of an auxiliary tank connected to the top of the main transformer tank by a suitable pipe and mounted above the level of the oil in the main transformer tank. The main tank and the connecting pipe are completely filled with oil, and the only oil that comes in contact with the air is that in the conservator. The size of the conservator is governed by the thermal expansion and contraction of the oil. The oil must not contract sufficiently to allow air to enter the main transformer tank, and when hot the oil must not overflow. In practice suitable oil gages, oil valves, chloride of lime chambers, and sump are provided in the conservator. The elimination of the air space in the main tank is of importance because this removes the chance of an explosive mixture of gas and air above the oil. Any gas that forms escapes into the auxiliary conservator tank, where there is no possibility of ignition.

Communication

Another Clandestine Wireless.—The steamer "Eten," which was the German steamship "Rajah Kootis," may have played a more important rôle in the war than merely that of housing a number of interned German sailors in a Peruvian port. Indeed, upon examination at an American port it was discovered that a water cooler in a stateroom of this steamer contained a wireless set. The obvious conclusion is that the interned crew may have communicated with German sea raiders at various times.

Safeguarding Radio for Emergencies.—The United States authorities who watch out for the welfare of wireless on land and sea, report that operators have been using their auxiliary source of power (storage battery) for the operation of audions. The auxiliary source of power must not be used for any purpose other than that of operating the transmitter in the event of accident, when the usual ship's current supply fails. The battery must be kept fully charged and ready for immediate use. Any defects in the battery or any other part of the radio equipment should be reported to the master of the vessel immediately. Such neglect of duty on the part of operators may be considered sufficient cause for the suspension or revocation of their license.

Light Telephony.—It is quite obvious that the Germans, too, were working along the lines of telegraphy and telephony by means of light rays during the late war. In a recent issue of a German periodical there appears a description of an apparatus for effecting telephonic communication along a light beam. The receiving apparatus consists essentially of a conical tube with a plano-convex lens at the wider end and a special selenium cell at the lens focus. The cell is included in a special valve amplifying arrangement to which are connected telephones. The transmitter consists of an arc searchlight, and the microphone current is superposed on the arc current by inductive coupling. The radius of such an arrangement is limited to three or four miles for small apparatus.

What Is It?—From Denmark comes a brief—all too brief!—report of the work of one Rahbeck, the inventor of something new in the field of communication. In company with one Johnson, Rahbek has been working for six years on the new invention. They discovered a new force resembling electro-magnetism in 1917, and eight days later they evolved the type of loud-speaking telephone of which the violin string appears to be the essential part. Next the inventors constructed a pocket electroscope far more sensitive and more easily handled, so they claim, than all previous instruments. One use of this new force which they have put to work would be to increase the receiving capacity of wireless stations. The inventors are now working on a device which will permit of despatches being received twenty times more quickly than now. All of which is interesting, to be sure; but what is it all about?

Recording Sounds with Light Rays.—In connection with the several light ray methods of communication developed during the war, it is interesting to note the latest means of recording and reproducing sounds by means of light. A. O. Rankine, writing in the *Proceedings* of the Physical Society, tells us that the light from a photophone transmitter is concentrated on a narrow slit, an image of which is produced by means of an auxiliary lens on a strip of motion picture film, the slit image being transverse to the film. The variations in intensity of the light when sound waves are received by the instrument are recorded as variations in the density of the film after development. For reproduction of the sounds, light from an illuminated slit is focused on the film, behind which a selenium cell, connected to a telephone circuit, is placed. As the film moves, the intensity of the light reaching the cell varies in accordance with the density of the film, and the corresponding sound is heard in the telephone.

British Cable Delays.—Considerable delays are reported by the Postmaster General in the handling of telegrams from Great Britain to the Continent. Of late the average delay on messages sent to the Continent was about 4½ hours, with a maximum delay of 22¼ hours recorded. By way of comparison, the delays experienced during the same period in the case of other services were also noted. The average delay on messages to North America via the Imperial Cable is reported to have been 3¾ hours, with a maximum delay of 10 hours. The services to the Near and Far East were subject to an average delay of about 10½ hours, with a maximum delay of about 24 hours. Recently the British Post Office instituted an "urgent" telegraphic service to Paris, at three times the ordinary rate, in view of the practice of many business men in London sending cables for Paris via New York. It is reported that a specific test was made recently to determine the advantages of the new "urgent" service to Paris. The message which went by way of New York was delivered in Paris 20 minutes before the one sent by the "urgent" direct cable.

Industrial Progress

Baedeker Again.—It is reported that the famous series of guide books known as Baedeker's, is again on sale in Germany. The first two volumes to come out are "Brandenburg" and "Saxony," thus indicating that Germany now is no longer to be regarded as one united state. Under the old régime there were four Baedekers of Germany. However, the thoroughness and accuracy of the text and maps alike remain at the pre-war standard of excellence.

A Guide to Latin America.—The need for a guide for commercial travelers to Latin America has just been met by a publication entitled "Commercial Traveler's Guide to Latin America," issued by the Bureau of Foreign and Domestic Commerce. For the convenience of the reader the book has been divided into two sections. The first part deals with general matters such as salesmen's equipment, transportation, suggestions for procedure upon arrival at destination, etc. Maps of Latin America accompany the guide.

Better Rubber or Cheaper Rubber?—A recent demonstration in India of a new process for the vulcanization of rubber took place at the Manchester College of Technology, it is announced in an issue of *Commerce*. Vulcanization of crude rubber mixed with a large proportion of waste material like leather shavings or sawdust was proved by this method to be chemically possible, as well as a saving in time and cost compared with existing methods. It is claimed that this process will produce a material which will stand the test of wear and weather.

Our Standing in Shipping.—According to Lloyd's Register of Shipping for 1920-21 just issued, the seagoing tonnage of the United States shipping has increased since 1914 by over 500 per cent. American tonnage now stands at 16,049,000 tons, which places the United States second only to the United Kingdom, which has 18,330,000 tons. Japan is now third, with 2,963,000 tons, followed by France with 2,963,000 tons. Including sailing ships, but excluding tonnage on the Great Lakes, the United States now owns 24 per cent of the world's tonnage as against 4.7 per cent six years ago.

Consumption Estimates, 1919, an annual publication of the Bureau of Foreign and Domestic Commerce, is now available. It presents condensed statistical tables showing production, imports, exports, and amounts available for consumption of various articles in the United States. Cotton, wheat, corn, sugar, wool, coal, pig iron, iron and steel rails, pulp wood, and tobacco are among the important trade items which receive individual attention. Copies are on sale at the Government Printing Office, Washington, D. C., and at the district and coöperative offices of the Bureau of Foreign and Domestic Commerce. The price is 5 cents.

Milk from Peanuts.—The common peanut is the source of a new substitute for milk which so closely resembles its prototype that it turns sour and curdles, produces butter milk when churned and may be made into cheese. The flavor, in which the nut characteristically persists, is declared to be practically its only point of variance with cow's milk. The new lacteal product originated in the laboratory of an American university where the peanut kernels are converted into four times their volume of milk, varying from 4 to 8 per cent in fat content and from 2.4 to 3.3 per cent in protein. The cost of production is said to be considerably less than the market price of dairy milk.

Is Europe Going Back to Bartering?—Trade with Germany on the part of Holland direct or on the part of other countries through Holland is becoming more and more difficult as a result of the exchange situation in Germany. The fluctuations of the value of the mark are great and violent, and the impracticability of forecasting the variations to even an approximate degree has made it almost impossible for German buyers

safely to import even the most necessary goods. Bartering has developed as one way out of the difficulty and is being practised to an increasing extent. For example, a deal was consummated recently for the sale of 1,000 tons of American flour to German importers for an equal value at current prices of coal-tar pitch.

Power and Fuels

Cotton Rope for Power Transmission.—The superiority of cotton rope over manila is emphasized in a recent issue of the *Journal* of the Engineering Institute of Canada. Though the initial cost of the cotton rope is the greater, its superior resilience, grip, groove impact and prolonged life—five times that of manila—quite outweigh the disadvantage in first cost. Cotton ropes evaporate acquired moisture quicker than manila and are less susceptible to internal mildew.

Steam Pipe Losses.—The German Association of Steam Users has issued a pamphlet calling the special attention of its members to heat radiation losses from the surfaces of steam pipes and boilers. It is pointed out that such losses with steam at a pressure of 170 pounds per square inch and a temperature of 374 deg. F. amount to 924 B.t.u. per square foot per hour and represent substantial sums owing to the high cost of fuel. The expenditure incurred in providing good non-conducting material is not serious and is repaid in two months by reduction in the coal bill. The radiation from flanges is practically the same as from the corresponding area of pipe, and it is recommended that an efficient type of flange cover should always be adopted.

Tidal Power.—The power available from tides at a given station is analyzed and graphical methods are given for determining the level in the tidal basin to give a maximum value for the mean power, in a recent issue of the *Genie Civil*. Since turbines only run in one direction, they should be placed between two parallel channels, one for the inflow during the rising tide, and the other for the outflow during an ebb. Since the fall is variable turbines should be operated in series when the fall is considerable, and in parallel when the fall is small. At peculiar states of the tides there are dead periods when no power is developed. This becomes less troublesome if, instead of a single station, a series of stations is erected along the coast. The dead periods will not fall at the same instant at the different stations. It is recommended that the installation should combine tidal, up-stream water reservoirs and thermal plants. The latter of course are to be used as auxiliaries when the water power falls below the requirement.

Wood Charcoal and Its Manufacture.—The uses to which wood charcoal is put are numerous, chief among which may be mentioned its use as a source of cheap power for running gas suction engines, for smelting purposes, and for smithy work. It is also used as a smokeless fuel and in the manufacture of ammunition. On account of its porous nature and the very large internal surface it contains, charcoal has the power of absorbing large amounts of gases. Similarly, charcoal, especially bone charcoal, prepared by heating bones, will absorb coloring matters from solutions, so that it finds a considerable application as a decolorizing and deodorizing agent. It is utilized also for insulating purposes, as it is a bad conductor of heat and electricity, and is given to poultry in crushed form. The chief constituents of wood are cellulose and lignin, both rich in the element carbon, and when wood is burned in the presence of air, light, heat and gases are produced, while ashes containing the mineral constituents of the wood form the residue. When heated to high temperatures without free admission of air most of its organic substances (cellulose, lignin, etc.) are decomposed and given off as gases, a residue of impure carbon remaining. This impure carbon residuum is called charcoal, and it consists almost entirely of the the element carbon mixed with a certain amount of still undecomposed carbon compounds and the inorganic constituents of the wood chiefly in the form of potassium carbonate.

Engineering

Making Good the Roubaix Canal.—Certain sections of the Roubaix canal were demolished by the Germans in their retreat in 1918, and it is the repair of these sections that *La Technique Moderne* recently described. The work carried out included the excavation of the canal bed, and the locks, work of checking the still apparently sound portions, remaking of damaged and destroyed portions, provision and erection of lock-gates, substitution of new parts for the temporary parts supplied and erected provisionally by the Allied Armies, construction of bridges to replace those destroyed, and other subsidiary works. The work was carried out very rapidly on the most modern lines, concrete being used largely in place of rubble and other materials. In the Roubaix section of the canal the whole of the ruins have been excavated, the canal bed dredged over a distance of 20 km.; 13 locks have been replaced, and 49 road bridges, viaducts, and foot-bridges re-erected over the canal.

T.N.T. as a Blasting Explosive.—The U. S. A. being left with millions of pounds of surplus T.N.T. on the conclusion of the war, the problem has arisen how best to utilize it in industry. Experiments made by the Bureau of Public Roads demonstrate that T.N.T. can be used with reasonable safety, but is not so economical as dynamite. It can be made more effective and also cheaper by admixture with sodium nitrate, ammonium nitrate, or other cheap oxidizing agent which will consume the excess combustible matter in T.N.T. It may also be desirable to add waterproofing material. Moisture and temperature do not materially affect the work of T.N.T., nor does it appear to affect the health of the user in open-air work. The amount of T.N.T. required for such work is about 75 per cent of the necessary charge of 20 per cent ammonia dynamite, continues the *Road-maker, Excavator and Grader*. On account of the smaller quantities used, definite sizes of cartridges should be made, since there may be considerable danger from overloads if the material is not properly cartridged.

Upward Pressure of Dams.—Experiments are described, which aimed at adding to the meager fund of information available regarding the upward pressures existing under masonry dams and other similar structures on porous foundation, in a recent issue of *Engineering News-Record*. The determinations were made at the Island Park Dam, Dayton, Ohio, and the apparatus employed was very simple. An unexpected discovery was that methane gas was accumulating in considerable quantities beneath the dam, and it was found that this gas had the effect of increasing the upward pressure, or the tendency of the dam to float. From the experiments it seems evident that although sheet-piling and cut-off walls are of value in reducing upward pressures, their effect is not necessarily in accordance with the line of creep theory. The results obtained are probably not representative of conditions existing immediately after the closure of the dam, and it is therefore concluded that the greatest danger exists when the head against such a structure is first accumulated. The upward pressure may soon be reduced to an unimportant factor, the length of time required to bring about the change being dependent upon the rapidity with which silt is deposited over the bottom. The formation of gas under the dam is a potential source of danger, if the shape of the structure is such as to confine the gas.

Pure Science

Radiotelegraphic Research at Woolwich. — According to *Nature* many important investigations in radiotelegraphy are under way at the experimental establishment of the British Army, at Woolwich. Speeds of transmission of from 450 to 1,000 words per minute are attained by an adaptation of the Wheatstone automatic transmitter. Special attention has been given to the linking up of line with wireless systems. High-speed messages, coming in over the wire in the ordinary way, are automatically transferred to the radiotelegraphic apparatus without loss of time in retransmission. The British Army is much interested in direction-finding apparatus, and very compact sets for this purpose, with a range up to 250 miles, are being standardized at Woolwich.

A New Journal of Physical Abstracts.—For more than three-quarters of a century the chief repository of physical abstracts for the world at large has been the *Fortschritte der Physik*, which, in recent times, has comprised three volumes a year. In order to ensure a more rapid dissemination of abstracts of current literature in physics, the Deutsche Physikalische Gesellschaft has discontinued the publication of the *Fortschritte* and a new semi-monthly journal, similar in contents, called *Physikalische Berichte*, has been started by the above-named society in conjunction with the Deutsche Gesellschaft für technische Physik. This publication will also supersede the *Halbomonatliches Literaturverzeichnis der Fortschritte der Physik* and the *Beiblätter zu den Annalen der Physik*. Dr. Karl Scheel, who edited the *Fortschritte*, is editor of the new journal, which is published by Vieweg & Sohn, Braunschweig.

Foodstuffs Fumigated with Cyanide Gas.—The Public Health Service has investigated the possibility of the adsorption or absorption and retention of cyanide gas by foodstuffs during the process of fumigating vessels, warehouses, etc., with resulting danger to the consumer. The foods selected for the test were fresh bread, which, on account of its spongy structure, offers excellent conditions for the adsorption of the gas, and milk, because it is the most available liquid food. The bread and milk were exposed to cyanide gas under a bell jar for periods varying from 2 to 22 hours, and subsequently fed to white mice. If given to the mice immediately after exposure to strong fumes of cyanide, poisoning resulted, probably from the fumes temporarily retained by the food. When the food was exposed to the air for an hour or two, it was harmless to the mice. The conclusion is that the possibility of poisoning occurring from food materials exposed to cyanide gas under ordinary conditions is extremely remote.

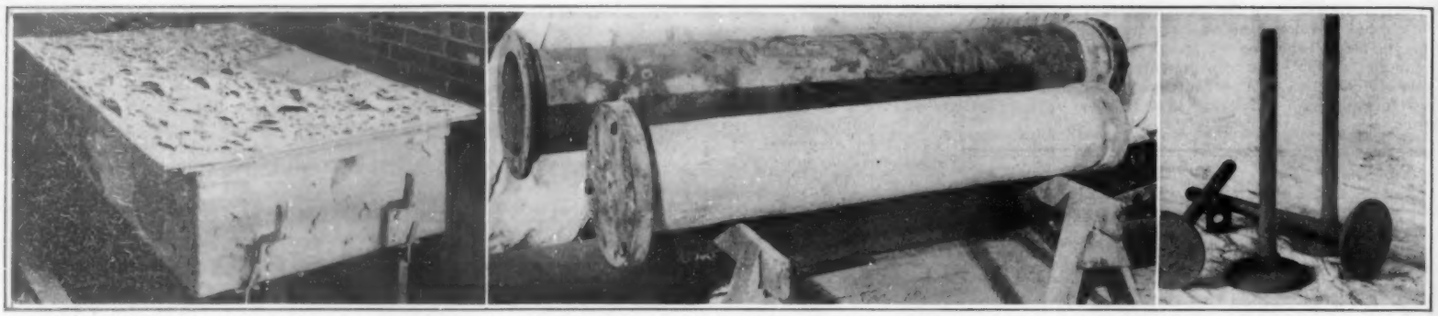
Motion Pictures of Weather Maps.—The U. S. Weather Bureau has been investigating the plan of making motion pictures of weather maps, as already carried out, in a tentative way, in Europe. Prof. J. Warren Smith, who has this matter in hand, reports that scenarios have been outlined to show: (1) The movement of a West Indian hurricane from the Atlantic into and across the Gulf of Mexico and thence across the eastern United States to the Gulf of St. Lawrence; (2) the movement of cold waves; (3) heavy rainfall and floods; (4) heavy snowstorms; (5) local thunderstorms and tornadoes; and (6) comparisons of the climate of different areas. The movements of storms and weather conditions will be shown by weather maps drawn for every 15 minutes, and each map will be photographed from 6 to 48 times. The maps will be accompanied by motion pictures showing the actual weather and its effects, including storm damage, waves on the coast, snow scenes, orchard heating to protect against frost, etc.

Automotive Progress

Change Oil in Crankcase to Prevent Wear.—A recent test showed that to prevent excessive engine wearing crankcase oil should be changed at least every 1,500 miles, preferably every 1,000 miles. A new engine that was run 6,000 miles with oil changed at proper intervals, upon being disassembled showed no signs of wear. The same engine, reassembled and run 6,000 miles with old oil plus new oil as needed, upon inspection showed a wear of 0.015 inches. Motor truck and passenger car manufacturers recommend, for better performance and longer life, that crankcases be drained every thousand miles, the engine flushed with kerosene and new oil added.

Growth of Motor Express Lines.—Motorized highway transportation is growing with astonishing rapidity. New York State alone has over four hundred motor express lines in operation. It is estimated that, for the whole country, there are not less than 5,000 such lines in operation. These lines are of greatly varying size and widely scattered. The American Motor Freight Company, with headquarters at Sioux Falls, South Dakota, is incorporated at $500,000. A map of its route includes 80 towns in Minnesota, Iowa and South Dakota. The New England Transportation Co., which operates out of Boston, is reported as having 150 motor trucks in service which operate over 12 routes totaling over 1,000 miles in length. The Patriot Motor Express Company, of Wichita and Kansas City, Kansas, is capitalized at $1,000,000. It is operating throughout Kansas, Nebraska and Missouri and will use 150 motor trucks.

Chicago Limits Truck Weight.—Amendments to the traffic ordinance in Chicago have been drafted to be submitted to the city council with a view to preventing rapid destruction of the street pavements by excessively heavy traffic. The proposed changes were discussed at a recent meeting in the office of the city engineer, Mr. Coombs, who is chairman of the special traffic commission charged with drafting the amendments. It is proposed to change the gross weight of vehicle and load from 40,000 pounds, as at present allowed, to 30,000 pounds, with a maximum weight of 1,000 pounds per inch width of tire, but it was agreed at the meeting that the combination of a motor truck and semi-trailer with load should be allowed a weight of 32,000 pounds, with a limit of 24,000 pounds on any one axle. During the meeting the city engineer said he was very much in favor of the use of trailers and felt it was preferable to have loads spread over the six or eight wheels of motor truck and trailer or semi-trailer rather than to have the weight concentrated on the four wheels of the machine carrying the load alone.



Left: An uncalorized sheet of iron and a smaller calorized rectangle of the same stock, after identical furnace tests—the untreated piece is covered with severe scale, the other is not affected. *Center:* Calorized (front) and uncalorized (rear) retorts after equal service. *Right:* Diesel-engine valves, a fair sample of the sort of thing that may profitably be calorized

Several exhibits designed to show the immunity to rusting under severe heat conferred by the new process of "calorizing"

Preventing Rust at High Temperatures

Aluminum-Coated Metals That Will Go to the Melting Point Without Formation of Scale

By Robert June

THE problem of devising means of protecting metals from oxidation at high temperatures has occupied the attention of metallurgical engineers for many years. The remarkable industrial developments of the past few years, particularly with respect to heat treating processes, have made this problem of pressing importance; and it has consequently received greatly increased consideration.

To say at the outset that this problem has largely been solved by the development of what is known as a calorizing process is to sum up the experiences and opinions of many metallurgists and industrial engineers who have encountered serious and at times seemingly unsurmountable difficulties in the rapid oxidation of metal parts at high temperatures.

In the calorizing process, the metal chosen is aluminum, and the protective action is due to the oxide formed by the action of heat on the protecting alloy rather than to any electrolytic relations between the aluminum and the base. The product is distinguished from that of other processes such as sherardizing, hot galvanizing, etc., in that these are intended primarily to give protection against oxidation at ordinary temperatures, or corrosion, as it is frequently called, while the calorizing process is intended primarily to protect against oxidation at high temperatures.

Practically all metals suitable for structural work, with the exception of those in the platinum group, began to oxidize at quite low temperatures; on the Centigrade scale, steel at about 370 degrees, copper at 360, nickel at 600, nickel-steel (58 per cent nickel) at 530, chrome-nickel (10 per cent chromium) at 650, German silver at 530, and aluminum-bronze (9.2 per cent aluminum) at 600. As a matter of fact most of these metals or alloys may be run at a higher temperature than that indicated before serious disintegration sets in, but none of them has a very short life at or above a full red heat.

It is well known that an aluminum wire heated by an electric current above its melting point will still maintain its shape due to the tough and resistant oxide of aluminum formed on its surface. It is this oxide which is the basis of the oxidation-resisting properties of calorized metal. It is necessary, however, to have sufficient aluminum present to form a continuous coating of Al_2O_3 over the whole surface. Experiment has shown that this requires, in the case of iron alloys, at least 14 per cent of aluminum.

The calorizing process was developed about 1911 in the electrical research laboratory at Schenectady, in the course of a series of experiments instituted to find a method of protecting electric heating elements. The process was later turned over to an independent corporation, as its industrial and commercial importance warranted its handling by a separate organization specializing in oxidation problems.

In treating metals by the calorizing process, they are first thoroughly cleaned by sand-blasting, then placed in a stationary or rotary retort in a reducing atmosphere, with a mixture composed of finely divided aluminum and aluminum oxide. This treatment, conducted at a temperature of 600 to 1,100 degrees Centigrade, depending upon the depth of alloy desired, so thoroughly infuses aluminum into the exposed portion of the metal being treated as to form a homogeneous aluminum alloy for a certain depth. This depth ranges from a few thousandths of an inch to the permeation of the entire mass, varying with the duration of the treatment.

The essential point in difference between the effects of calorizing and most of the processes hitherto used commercially, such as galvanizing, plating or coating, is that the protective metal is not imposed as coating or skin upon the metal to be treated, but rather enters into intimate association with it, forming a "solid solution" alloy. For this reason, should the outer surface become slightly injured, the protective surface renews itself. Calorizing is not intended to protect against rusting or corrosion, as is sherardizing for example, but is primarily a protection against burning or scaling. Calorized copper, brass and nickel, however, are also excellent non-corrosive elements and are strongly resistant to the acid. The dimensions and weight of the metal treated are very slightly increased by calorizing. The increase in dimensions is usually not over a few thousandths of an inch.

An example of its commercial application is in the manufacture of soot blowers, which as applied to boilers must be exposed continuously to furnace gases at high temperatures, and are not cooled by water or steam as are boiler tubes. Ordinary iron or steel will not give successful service. Under these conditions, one of the early means employed in protecting this equipment against burning out consisted of two extra heavy steel pipes, placed one within the other, the space between being filled with insulating material of special composition. This type of installation was fairly successful, but involved an excessive first cost; therefore, manufacturers of soot blowers were constantly on the lookout for material from which these units could be economically made, and which would give even more satisfactory results. Very soon after the calorizing process was announced, a comprehensive investigation of it was made in this application.

In addition to mechanical tests, trial installations were made in all the different types of water-tube boilers. In making tests, calorized soot-blower units were placed in the hottest passes where the temperatures ranged from 1,800 to 2,500 degrees Fahrenheit. The need of blowers at these locations had long been recognized, but their application had been considered impracticable. Performance of the calorized units was watched with keen interest for months. In the end they proved that they fully met the hardest service conditions. There were no signs of scaling or disintegration from the long exposure to high temperatures. Thousands of successful installations have been made, and are now giving satisfaction in all types of water tube boilers. In addition to the matter of oxidation, many gases contain sulfur dioxide and carbon monoxide, which have an extremely deleterious effect on ordinary metal, while tests have shown that calorized metal is not affected by them in the percentages in which they occur in furnace gases.

The resistance of calorized iron to oxidation is a time-temperature function. It will resist oxidation up to its melting point for a short time, but to obtain a reasonable life, temperatures exceeding 900 to 1,000 degrees Centigrade should not be used unless the calorinzing treatment was unusually heavy. The reason for this is evident when we consider that the diffusion of the aluminum into the iron is extremely rapid at high temperatures. It is about five times as fast at 1,300 as at 110 degrees Centigrade, which would cut the life to one-fifth when used at the higher temperature. By using thin sections and a heavy coating, however, steel may be calorized to stand the higher temperature for months.

Although tests show that the mechanical properties of the steel are not injured by calorizing, it must be pointed out that the rich aluminum alloy which forms the protective coatings is very hard; any bending or mechanical working should be done as far as possible before calorizing. If it must be done afterwards, the piece should be first heated to redness. Calorized metal cannot be hammered or bent cold, but at a bright red heat can be bent without affecting its resistance to oxidation. However, calorized metal is capable of withstanding all ordinary handling without destruction of the alloy or calorized portion.

Calorizing has been put to a great variety of uses including its application to retorts, carbonizing and annealing boxes, pyrometer tubes, furnace castings, tubes for preheating air, flue lining, pipe for conveying molten glass, torch nozzles, blast furnace tuyeres, oil crackers, soot-blower units, lead pots, valve and piston heads for Diesel engines, preheating coils for oil burners, hot bulbs for oil engines, etc. Calorization has been successfully applied to carbonizing and annealing boxes and a variety of heat treating equipment of this nature, the treatment prolonging the life from three to thirty times.

It is entirely feasible to make up calorized coils of pipe in a wide variety of

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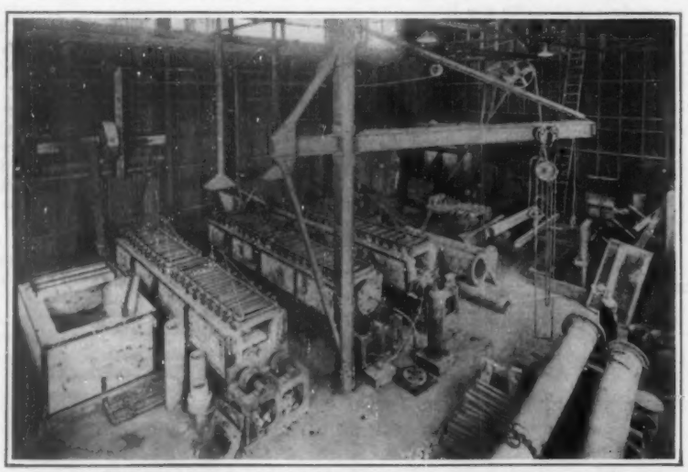


Retorts and furnaces in which the calorizing process is carried on

A Pocket Machine Gun

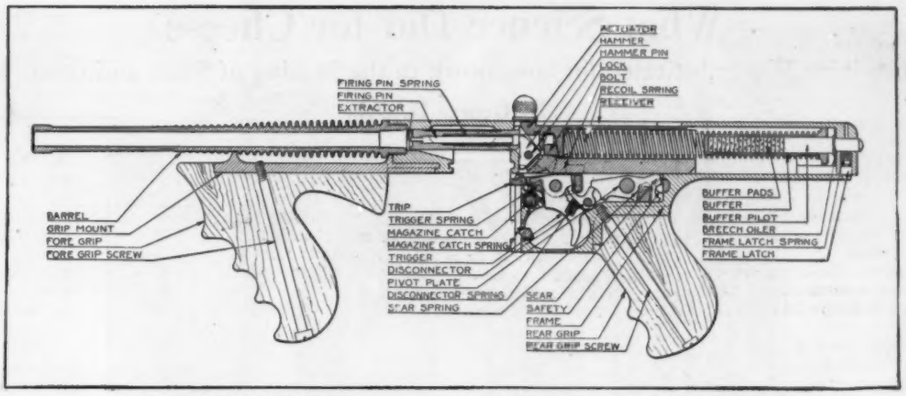
By Capt. E. C. Crossman, U. S. A.

THE marksmanship of the average policeman with the average policeman's revolver is something to make honest men turn pale, and the women and children duck for the subway. Here and there are exceptions, but as a general rule policemen seem far inferior to yeggs when it comes to hitting things they intend hitting with the pocket gun. I do not know whether the yegg spends some portion of his ill-gotten gains in target practice or whether his ability to hit, where the officer misses, is due merely to the cussedness of inanimate nature. The fact remains. Wherefore the announcement in the public prints of the adoption by the New York police of the wicked little Submachine Gun is of course interesting to those persons who wish to see the customary New York brand of gunplay made a little less one-sided.

Without doubt the early future will see a happy coincidence of a policeman skilled in the pointing of the new weapon, and an automobile full of yeggs willing to engage in the customary running gun flight. The result will be the worst-shot-up assortment of crooks that has come to the attention of the coroner.

The new gun as adopted by New York consists of a 7-lb. weapon, 22 inches over all, and capable of being carried in concealment. It is sort of a compromise between a pistol and a rifle, with the speed of fire of the highest speed aircraft machine guns. It is turned out by a new and strong organization headed by the former Assistant Chief of Ordnance of the Army, the officer who gave to the Army the M 1917 rifle during the war.

As designed for American use it is chambered for the caliber .45 automatic pistol cartridge, with its powerful and knock-down blow inflicted by the 230-grain bullet. The barrel is less than a foot long. A grip for the left hand lies below the center of the barrel, while another for the right hand lies near the rear end of the gun, below the breech casing. The magazine is between the two grips.



Cross-section of the pocket machine gun, showing its components and the general assembly

So arranged, the gun is intended to be fired from the waist line, the fire being directed by the sense of feel, as one throws a stone, and as used in the "marching fire" of attacking infantry during the war. The arm is truly automatic, not the semi-automatic self-loading type so often miscalled automatic. Such arms require a pull of the trigger for each shot, the mechanism merely ejecting and reloading the gun. The Submachine Gun is a true machine gun in that it fires as long as the trigger is held back and the cartridge supply kept up. This particular arm, however, has a theoretical speed of fire of 1,500 shots per minute, higher than any other weapon on earth, and three times as high as the average of machine guns used for land use among various armies.

If the trigger is held back, the result is a verberating roar of shots coming so fast that the ear cannot distinguish them apart. This of course empties a twenty shot magazine in less than a second; but the fire is easily controlled by the trigger pressure, and I found no trouble in firing single shots merely by a quick pressure of the trigger and instant release. Any number of shots between the single shot, and the entire capacity of the magazine is thus at the disposal of the firer.

Were the gun designed for a military cartridge and of this weight and proportions, it would of course be absolutely unmanageable in automatic fire. Those who have used the 16-lb. Light Browning automatic rifle can testify to the difficulty of keeping the gun from whirling the firer around and twisting the gun toward the sky. The recoil of the .45 pistol cartridge, however, is very light, and the writer, accustomed to handling the Light Browning rifle, found it easier to control the fire of the Submachine Gun than the Browning automatic rifle. The gun is fed by magazines of varying capacity from the flat, box-type, 20-shot affair, to the drum-shaped carrying 50 or 100. A feature of the arm is its absolute simplicity and fewness of parts. When resolved into its components for cleaning one can discover only fourteen or fifteen parts, and the gun is taken down without a tool and in a few seconds.

The arm is novel in that its designers arranged it to be oiled—as they say like any other gas engine, which is of course the correct classification of the automatic rifle or machine gun. Felt pads lying within the receiver walls and so out of the way of dust and grip, are impregnated with oil, which the bolt picks up in its reciprocating motion. The advisability of oil in a machine gun for military use is open to question, but the certainty of function of this little gun, and its terrific rate of fire evidently owe much to the oiling of the parts and lead to thought as to whether or not this is not desirable with any other weapon of this high speed, heating and hitherto rather unreliable type. Nothing more elaborate is required in this oiling than a squirt of an oil can into the pads every 500 shots or so, nor will the gun cease to function if it is not oiled.

The writer, as fire control officer of the Small Arms Ballistic Station at Miami and Daytona, Fla., conducted by the Ordnance Department of the Army, was

(Continued on page 413)

1—New York policemen using the new pocket machine gun which fires .45-caliber automatic pistol cartridges at the theoretical rate of 1500 shots per minute—higher than that of any machine gun. 2—The pocket machine gun fitted with the 20-shot box-type magazine, and gun butt. 3—The pocket machine gun fitted with the drum-shaped magazine carrying 50 or 100 rounds.

Two types of pocket machine gun magazines and how the gun is used by the New York Police Department

What Science Did for Cheese

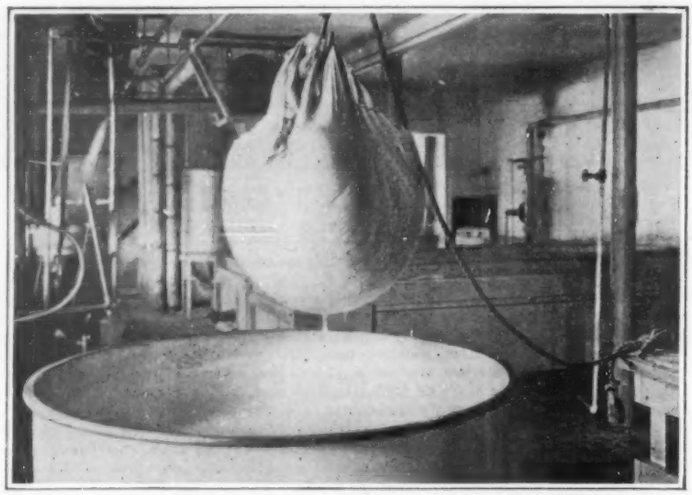
How Precision Was Substituted for Guesswork in the Making of Swiss and Other Varieties

By George H. Dacy

ONE of the most recent scientific discoveries of the National Department of Agriculture has eliminated the gamble from Swiss cheese manufacture and has made it possible for American cheesemakers to produce better cheese than the best which ever emanated from Emmental, Switzerland, the Alpine native heath of dairy delicacies of this description. The art of Swiss cheese making—for it was an art which was handed down from generation to generation of hardy Switzers—was never dependable: the maker—no matter how experienced and skilful—was always liable to run into snags in the way of unfavorable climatic conditions or other environments which proved prohibitive to the rapid multiplication and activities of the organisms which framed the holes in the cheese and imparted to it the sweet, nutty flavor characteristic of the best imported Swiss cheeses.

We American consumers as a class were not familiar with these inside facts of the manufacturing complexities, because none but the best Swiss cheese was ever exported from Switzerland. However the prices which we had to pay for these imported food-products were accurate reflections of the trouble and losses involved overseas in their manufacture. Under the rule-of-thumb methods which previously have been typical of Swiss cheese production, ordinarily only from 40 to 50 per cent of each batch of cheese that was made was high grade while the balance was of inferior quality, selling for low prices. More than five centuries of experience in cheese manufacture were fruitless so far as the standardization was concerned and assurance that a certain proportion of high quality material would obtain from the operations of the maker supplied with plenty of milk and allied conditions necessary for Swiss cheese production.

In 1845 twenty-seven families of Swiss migrated to Green County, Wisconsin, with the intention of establishing the Swiss cheese industry in the United States. Natural conditions were as favorable as they were in Switzerland for the development of dairying in the Badger State. However, the same impediment which had proved insurmountable abroad obstructed the rapid rise and expansion of the business in America—the inability of the makers to standardize the processes of manufacture and to guarantee a definite and dependable output. Appreciating that the Swiss cheese industry presented profitable opportunities and afforded a remunerative market for milk if permanently established in this country, specialists of the National Department of Agriculture some years ago essayed the task of solving the perplexing conundrum.



Potcheese is made in the home by just this process—but hardly on this scale. The housewife would be puzzled by a draining bag that must be handled with a half-inch rope

NUMEROUS jests have been cracked about the holes in Swiss cheese, and the man whose job it is supposed to be to make them. But when the experts of the Department of Agriculture tried to get at the bottom of this business, they discovered that even the cheese-makers of Switzerland knew nothing about it, their methods merely working because they worked. It required, in fact, twelve years of investigation and experiment before the particular "bug" that is responsible for the holes and the distinctive flavor of the Swiss product was isolated and put on his good behavior. This and several related stories Mr. Dahl tells in this account of what the Government scientists have done for the American cheese industry.—THE EDITOR.

These experts spent much time with the Swiss cheesemakers in America, striving to gain insight into the riddle from carefully studying the various operations. The cheesemakers themselves knew absolutely nothing about the scientific principles involved. They did such and such a thing merely because their fathers and grandfathers had done likewise. Completely baffled in their attempts to wheedle illuminative information from the domestic producers and unable to reduce the knotty problem to a brass-tack basis by their laboratory experiments, the experts finally went to Emmental, where they investigated intensively and left no stone unturned in their untiring efforts to crack the tough-coated nut. However no one in Switzerland knew the "why" and "where" of the various operations which they performed in making Swiss cheese so that ultimately Uncle Sam's scientists had to return to this country without a solution for the question, "What causes the holes in Swiss cheese?"

Bewildered but yet undefeated, the agricultural experts resumed laboratory investigations with the full appreciation that if the problem were ever to be solved it would have to be cleared up through scientific experimentation. They extracted all the bacteria—of which there were 1,000 and more—from a fine sample of imported Swiss cheese. By an elimination process, they subsequently tested out each individual bug, in turn, despite that it took twelve years to complete this highly technical exploration. The results were not promising until finally the experts decided that a change of media for the development of the bacteria was necessary. The solution of the conundrum hinged on the use of the new culture medium. Shortly the scientists isolated the particular organism which formed the holes in Swiss cheese and thereafter they revamped the entire method of production to a strictly chemical and technical basis, with the consequence that, at present, it is possible to guarantee that at least 90 per cent of the cheese crop which is made according to the new methods will be of excellent quality, adapted to suit the requirements of the most critical trade.

Heretofore, we have consumed about 20,000,000 pounds of imported Swiss cheese annually while our domestic output according to the old methods of manufacture had almost reached a similar production

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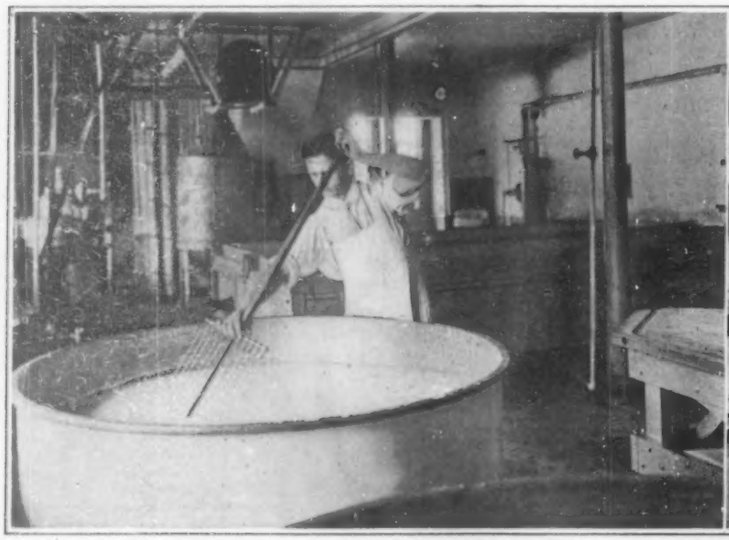


The novel design of this stirring tool is an essential feature

Swiss cheese sojourning in the curing room

Stages in the manufacture of Swiss cheese, according to the scientific methods worked out by the Department of Agriculture

Weighing less than 200 pounds, this two-passenger car runs 75 miles on a gallon of fuel

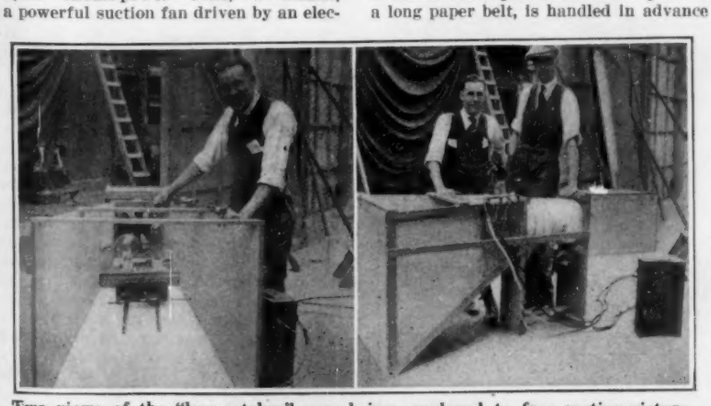
Speaking of Automobiles—Here Is a New One

A NEW little car, being developed by a Chicago concern, is intended to attract resort trade and the tourist. It will fit in a trunk, if the trunk is large enough; of completely knock-down construction, on a buckboard chassis with motor-wheel behind, with room for two full grown people and a weight of but 200 pounds, it will catch the trade of those who need some rapid means of transportation to get over the country. On a gallon of gasoline it will run from 75 to 80 miles. By loosening screws and bolts in a very few minutes it can be turned into a roadster or small touring car. Complete control is from the steering wheel.

Eliminating the Troublesome Motion-Picture Bug

THERE is the motion-picture "bug" who is forever trying to worm his or her way into film productions. There are tens of thousands of such "bugs," and they are familiar to all of us. But this story has to do with another species of bug whose number runs into the millions, yet whose activities are more or less unknown to the general public. This species of motion-picture bug is the moth which flies around the powerful lamps of the indoor studio, and which has heretofore been responsible for many thousands of feet of wasted film.

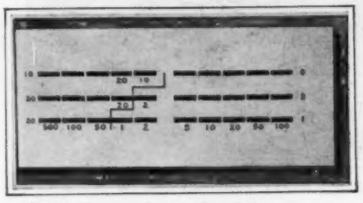
It has remained for F. S. Mills and Clyde Ewing, motion picture men of Hollywood, Cal., to invent a machine that does away with the troublesome motion-picture bug—the winged variety, of course. This machine, which is shown in the two accompanying illustrations, consists of a wide box, a carbon arc, two incandescent lamps of 2,000 candle-power total, a funnel, a powerful suction fan driven by an electric motor, and a large box-shaped net. The operation of this device is simple. The bugs are attracted by the lights and on flying toward them they must pass over the arc. The intense heat burns them while the suction fan draws their remains into the box-shaped net. In a recent test the machine netted nearly ten pounds of bugs in less than that many minutes. By number the total haul was estimated in excess of 12,000 bugs. The lights of the apparatus are turned on during the rehearsals, so that all the bugs in the immediate vicinity are harvested, so to speak, leaving the air free until the banks of arc lamps or mercury-vapor tubes are flashed on for the actual filming work.



Two views of the "bug-catcher" now being employed to free motion-picture studios of troublesome moths

Handling Paper Money by Push Buttons

WORKING on the problem of handling paper money by machinery, Frederick C. Weber of New York City has evolved a machine which appears to be as practical as it is ingenious. This machine consists of a cabinet divided into suitable compartments for holding the paper money, and topped with a



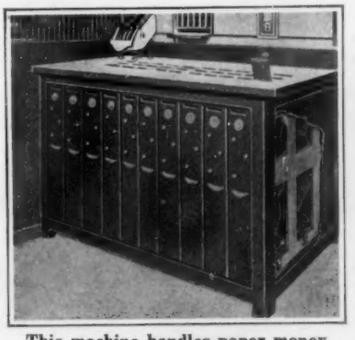
Typical panel used with paper-handling machine, showing the arrangement of slots

panel containing slots and push buttons. The paper money is wrapped in paper bands which feed out through the slots. The paper bands are divided off into envelopes which, due to the perforations separating one from the other, can be immediately torn off, thus forming a separate envelope with the money enclosed.

The machine contains a large number of envelope bands, as they might be called, containing various denominations and amounts of paper money. As will be noted by the keyboard depicted in one of the accompanying illustrations, the money is wrapped up so that any amount can be obtained by pushing the proper button. Thus by pushing a certain button the envelope comes through the slot in the lower-right hand corner, containing 100 one-dollar bills. The next slot to the left contains packages of 50 one-dollar bills. The next, 20 one-dollar bills, and so on. The arrangement of this panel is optional, of course, and can be designed so as best to suit any particular requirements.

The paper money, wrapped up in individual envelopes which form part of a long paper belt, is handled in advance by the average office help. Away from the rush and turmoil of the cashier's desk, this work can be carefully done and duly checked to avoid errors. The paper belts are placed in the machine at the beginning of the day's business. As for the handling of these belts, this function is taken care of by an electric motor driving an arrangement of rollers, which feed out one envelope at a time, which can be torn off; indeed, the action is similar to that of the automatic ticket machines now used in many motion-picture theaters.

The new paper-handling machine can be used in conjunction with the usual coin-handling machine. It does away with the long waiting line of customers. It relieves the nerve strain of accurate counting of money, and enables the teller to wait on two or three times as many customers as at present. It furnishes an automatic record of all money paid out and the cash balance of every denomination on hand. It is claimed to be proof against daylight holdups; it is sanitary.

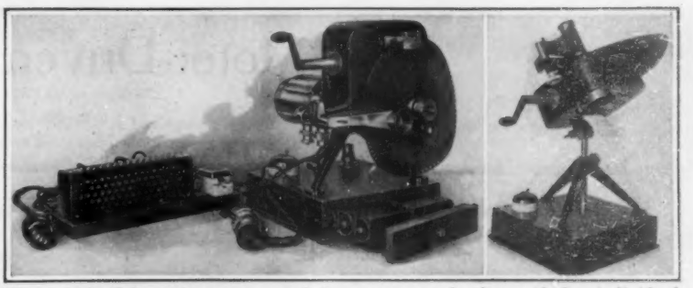


This machine handles paper money with as much facility as the usual coin-handling equipment

Home Motion Pictures in Disk Form

IT has remained for Charles Urban, a pioneer worker in the field of motion pictures and the inventor of one of the most successful processes of natural-color motion pictures, to introduce a simple motion-picture apparatus for home and kindred use. By replacing the usual film with flexible disks, this inventor has simplified and reduced the cost of motion pictures to a point where they are available in almost every home.

The basis of the present system is a transparent disk on which the images are arranged in a continuous spiral. It has been found impractical to utilize a disk negative for photographing the subjects, hence the process makes use of standard positive motion-picture film which is projected in greatly reduced form on to the master disk. Once this master disk, which is a negative, is obtained, it is possible to print any number of positive disks for use in the projector. This reduction process requires most precise handling, and it was only after many years of constant development that the present successful results were obtained.



The spiral disk projector as used for screen projection and for individual viewing of pictures

The projector, which is shown in the first of the accompanying illustrations, embodies the usual elements. It has an incandescent lamp, condenser, shutter, lens and an intermittent gear. The operation starts with the first image on the outer turn and follows the spiral to the innermost image. Obviously, the pictures do not have to be rewound, as with standard film.

The actual size of the images is 7/32 by 5/32 inch. The 10½-inch disk contains 1,200 pictures, or the equivalent of 75 feet of film, exclusive of titles. Only two frames are devoted to titles, since the machine can readily be stopped when a title is reached, and then started up again, thus saving a great number of frames. In this manner the record may be said to equal the usual 100-foot run of film with titles. This matter of being able to stop the pictures at any point also aids in studying any given bit of action—something which is generally impossible with machines utilizing regular film.

By removing the lamp and substituting a small mirror as shown in the second illustration, the projector can be used by an individual for viewing a picture without going to the trouble of putting up a screen, darkening a room and making the necessary electric connections.

Safety for the Linemen

ELECTRICAL linemen follow a vocation which is precarious even when surrounded by utmost safeguards, high-powered circuits involving extreme precaution by the workmen lest injury or even death result from immediate contact with electrically-charged wires. Obviously, the rubber gloves worn by linemen for handling high-voltage circuits should be able to withstand severe usage, frequent tests determining this factor. Such is the object of an apparatus designed by the U. S. Bureau of Standards, the device revealing the

(*Continued on page 415*)

Testing linemen's rubber gloves to preclude their breaking down under actual working conditions

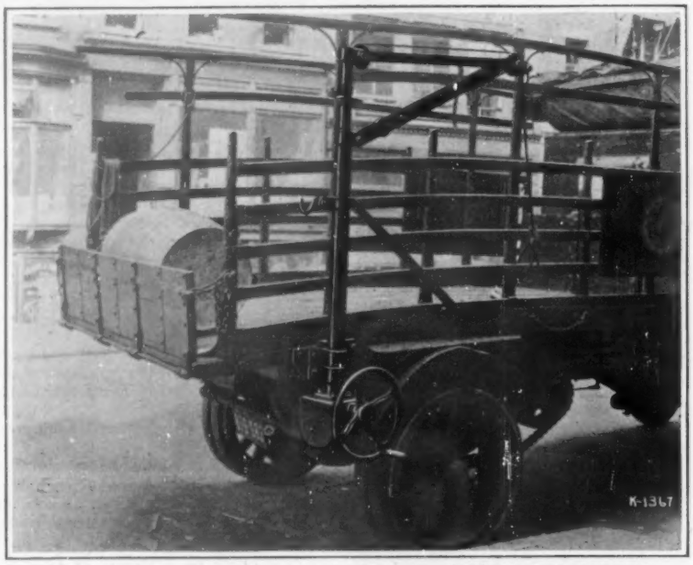
The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Simple Hoist for Trucks

THE problem of loading trucks with heavy objects is not an easy one to solve in a large city because it is not always possible to back a truck up to a curb and use skids on which heavy objects such as boxes, barrels or pieces of machinery can be raised from the street to the truck platform. A simple elevating crane which is shown in the accompanying photograph has been devised by a New York manufacturing concern to facilitate handling heavy objects. It is composed of heavy iron pipe which comprise the pillar and arms made of bar iron. The pillar is supported by clamp members and the portion carrying the iron arm may be swung to the rear of the truck and when the load has been elevated to platform height it may be moved over the truck bed and the load deposited thereon. The hoisting cable runs down through the center of the hollow pillar to a gear-actuated winding drum carried in the base casting. A large hand wheel with handle extension from the rim is provided so the winding drum may be operated by one man without great exertion. It will be evident that this simple fitting may be used to good advantage on any truck having a rack-side body and used for general transfer purposes. By its aid one man may easily load large boxes and barrels that would be a severe tax on the strength of several men if loaded in the usual manner.

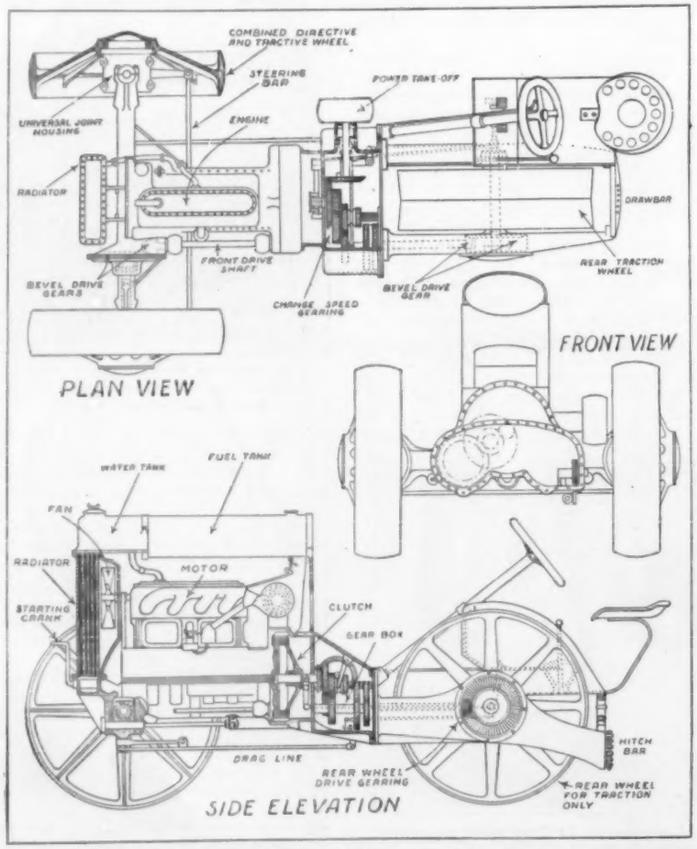


This simple crane permits of swinging heavy loads on and off truck

New English Tractor

THE accompanying illustration shows a novel design of a three-wheel tractor for agricultural and road building use that has been devised by an English manufacturing company. In some respects the tractor follows late American practice inasmuch as it is the form that has no frame other than that provided by the engine base, gear box and extensions attached to the latter member to which the rear wheel is secured. Among the novel features of this tractor other than the adoption of the frameless system of design is the provision of power transmission mechanism to all three wheels. The two front wheels are combined directive and tractive members. The steering knuckles are exceptionally large and house in the universal joints by which the wheels are driven. The main drive from the change-speed gear case is by means of a double universally jointed shaft extending from the front end of the gear case to a differential housing on the front axle in which the main drive is by bevel gear reduction. The single rear wheel is operated by a shaft which carries a bevel pinion that engages the bevel gear on the wheel-supporting axle.

A power take-off is provided by which bevel gears transmit the power from the clutch shaft to a pulley at the side of the gear case to which a belt attachment can be made for driving any forms of machinery that would ordinarily be operated by belt power. The application of power to all three wheels of a light tractor is an attempt to secure maximum traction and the machine should have a greater effective draw-bar pull than any three-wheeled form of the same weight delivering the power only of one driving wheel, as is the usual construction when the three-wheel design is followed. The tractor illustrated shows clearly the influence of American practice; and the method of dispensing with the frame by using the engine base for that purpose, the incorporation of a clutch and change-speed gearing as a unit with the engine and also as part of the frame structure, and the support of the fuel tank and installation of the radiator, are all very evidently copied from a well-known American tractor design that was produced in large quantities during the war in both this country and in England. The tractor illustrated is distinctive in design, however, in the method of power transmission. The general features are so clearly brought out in the illustration that further description seems to be unnecessary.



Details of a new three-wheeled tractor of English design

Motor-Truck Life

THE life of motor trucks has formed the subject of many articles. While most of the articles have been radiant with optimism, they were unfortified by fact for the very simple and sufficient reason that the fact was not available. Lately, the records of economy, efficiency and durability have been accumulating rapidly with the increasing care given to watching truck performance and it is now possible to substantiate many of the assertions of former years.

It is not an uncommon thing to read of the remarkable records of some quite old and certainly well worked machines. Those who used to argue for a scheme of depreciation based on an estimated useful life of 100,000 miles and who won little beyond scorn or good-natured toleration for their pains, now enjoy the satisfaction of seeing the proof presented in convincing form and volume One manufacturer has repeatedly drawn attention to the fact that numerous machines of his make have reached that mileage, while many others have exceeded it, some being still in service after more than 300,000 miles of economical travel. On an estimated average daily mileage of 50, which is very common in many lines of trade, this means, in the maximum case cited, a time-life of twenty 300-day years, or at least ten years, were the daily mileage as high as 100. Even a life of but 200,000 miles indicates a time-life of 13 years and 4 months at the rate of 50 miles a day. In such a case depreciation, considered as an annual rather than as a mileage charge, is no greater than 7.5 per centum instead of the 33 1/3, 25 and 20 per centum figures so frequently employed by operators.

Mobile Shoe-Repair Shop

TWO special trucks built by a well-known Detroit manufacturer and especially equipped for the United States army as mobile shoe-repair shops, recently passed through New York on a test trip from Boston to Washington, D. C. The purpose was to show how easily such an outfit can be moved from place to place, what speed can be maintained and how it will stand up under a 500-mile road test. The first truck carries all the necessary machinery for remaking and repairing shoes, which is driven by a separate motor connected with the driving shaft of the standard stitching machine, the nailer, the scouring and finishing wheels. This motor also furnishes electric lights through a dynamo, and heating facilities are provided through registers connected with the exhaust.

The second truck is equipped as a supply depot, and carries all the materials for repairing soldier's shoes, such as sole leather, heel lifts, hob nails, tacks, welting and other necessary findings as well as extra machine parts for both the trucks and machinery. This supply truck can also be used to dispatch repaired shoes to various points along the lines where troops are located. Army officials estimate that approximately 800 pairs of shoes a day can be tapped when the mobile outfit is running with a day and night crew of seven men. There is also carried a complete set of apparatus to pull the trucks out of snow drifts or mud, consisting of ground anchor, winches, ropes, chains, picks, and shovels.

Concrete and the Building Crisis

(*Continued from page 399*)

the concrete. From the ground level up, in the building we are describing, the same forms answer for each successive floor.

Generally, these forms are constructed of wood and have the surfaces contiguous to the concrete oiled so that they will strip readily and smoothly. The molds for the columns, however, are of sheet steel and composed of a number of segments held in place by suitable rings or straps. By omitting one or more of these segments it is practicable to use the same molds in casting the smaller columns for the upper floors. The actual progress being made in building this structure is a floor per week.

In some undertakings, buildings are reared by using sliding forms for the monolithic concrete walls, the forms moving upward as the material sets. This method of construction permits of continuous operation throughout twenty-four hours daily. Necessarily there is economy in form outlay. Reinforced concrete has been successfully employed in fashioning concrete roof girders having a span of fully 80 feet. Because a reinforced concrete building is fireproof, it is possible to obtain very low insurance rates, and this is an item not to be overlooked nowadays. Finally, it should be recalled that concreting in cold weather is entirely practicable, and work can be carried on satisfactorily the year through if certain precautions be taken to shelter the newly laid concrete from frost and to heat the sand, pebbles or broken stone, and water before mixing. And cement grows stronger with age—differing in this particular from a good many other structural materials.

The Aerial Cruiser

(*Continued from page 400*)

control car and there is telegraph communication to all the other cars. The motive power consists of four engines, two in the machinery section of the forward car, and one in each wing car. Each engine develops a maximum of 230 brake horse-power at 1,400 revolutions per minute. The engines are six-in-line vertical, with overhead valves (two inlet and three exhaust per cylinder).

Supply Systems

The petrol is stored mainly in the keel corridor in 92-gallon vertical tanks. There are 34 tanks giving a total capacity of 3,128 gallons weighing about ten tons. Seventeen tanks may be readily slipped overboard to act as ballast.

Water Ballast

The water ballast is in two sections, one for emergency, the other for maneuvering. The emergency ballast bags discharge their whole contents when operated. The maneuvering bags may be liberated in any proportion at will. The weight of the emergency water is 2,000 pounds forward and 2,000 pounds aft. The four maneuvering bags have a capacity of 2,200 pounds each.

Armament

R-80 has been designed to carry the following armament:

- 8 230-pound bombs, stowed horizontally in the keel, and released electrically from the control car.
- 1 automatic quick-firing 2-pounder, and 1-cluster of two Lewis guns mounted on the top gun platform, forward.
- 2 Lewis guns in the tail gun position.
- 2 Lewis guns, one on each beam, in the forward control car, and
- 1 Lewis gun mounted in each wing car.

Accommodation

Separate quarters are provided in the keel for officers and men who are not on watch. The cabins have tables, chairs,

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The Measure of Hack Saw Efficiency

Efficiency in the case of Hack Saws is measured both by the length of service and by the speed with which they cut. No purchaser, except one using an enormous number of blades, would ever dream of having his saws made to order, and so for practically all cases, the manufacturer determines what the saw shall be. He has the experience, the knowledge and the equipment which makes possible the manufacture of saws in the quality and quantity that are necessary to meet the many and diverse needs of industry. But his service to the purchaser is not complete unless he makes it possible for the latter to select instantly the particular saw best suited to the work in hand. Experience has proved that this may be most satisfactorily accomplished through the medium of a Hack Saw Chart based, not upon the characteristics of the saws, but upon the different materials which have to be cut in ordinary work, thus enabling the machinist to select always the proper blade by looking, not for the number of a blade, but for the name of the material he has to cut and employing the blade indicated under that heading on the chart.

As materials differ in texture of fibre, hardness and shape, so must the saws vary if we are to attain economy in the cutting-off department. When the right combination of saw and material has been made, the burden of responsibility rests upon the operator. It is his task to see that the greatest output is secured for the least cost for saws, labor, and overhead.

Economy is more than a mere reduction of first costs. As a matter of fact, consideration of first cost only usually results in inefficiency and an increased ultimate cost.—from *Hack Saws and Their Use*, published by The L. S. Starrett Co., Athol, Mass., for free distribution.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.

Electrical Devices

EMERGENCY LAMP.—W. J. KOENIG, deceased; address Ralph De Ross, 410 E. 29th St., Brooklyn, N. Y. In order to adapt this lamp for use about machine shops, engine rooms, automobiles or the like it is provided with an electromagnet serving to hold the lamp automatically in any desired position on or against any metallic support. The magnet circuit is a branch of the lighting circuit, and the magnet is energized while the lamp glows.

Of General Interest

VEGETABLE PEELER.—J. H. HAMLIN, 430 11th Ave., New York, N. Y. Among the objects of the invention is to provide a vegetable cutting and peeling implement adapted to easily and quickly remove the peeling of a potato without waisting that part directly beneath the skin. Another object is to provide a hand-operated implement having a self-contained reservoir of water to flush the surface of the vegetable being peeled, and to provide an abrasive implement with sharp points for removing eyes or faulty portions of the vegetable.

EVER-SET CAGE TRAP.—H. ROHLFF, 332 W. 2nd St., Davenport, Iowa. The invention has reference more particularly to a self-operated ever-set wire cage trap which is especially adapted for trapping birds. The prime object is to provide means for trapping and confining birds without injury. A further object is to construct the trap so that there will be no chance for the birds escaping, yet the trap entrance is always set and capable of operating an unlimited number of times without attention.

RECEIPTACLE COVER.—A. SWENSON, 141 Valley Brook Ave., Lyndhurst, N. J. This invention relates to receptacles for holding sugar, fruit or other articles of food. Among the objects is to so construct a cover for this type of receptacle that it may be readily removed from the body in order that all parts may be thoroughly cleaned, thus rendering the article sanitary.

WASHBOILER.—A. T. TIMOSCI, 668 Willis Ave., N. E., San Jose, Cal. The object of the invention is to provide means in connection with wash boilers of usual construction, for supporting the garments to be washed above the bottom of the boiler, the support being arranged in such manner that the garments will be held loosely on the support, and in such manner that the cleansing fluid may flow inward with respect to the support and garments.

WINDOW SEAT.—D. F. CROWE, 1554 Ligonier St., Latrobe, Pa. The invention has for its object to provide a device of the character specified, capable of being seated upon the sill of a window in such position that one seated in the seat may have access to the outer face of the window sashes of the window without danger of falling.

ASH RECEIVER AND SIFTER.—P. H. CHILDRESS, Box 317, Waynesboro, Va. The primary object of the invention is to provide an ash receiver and sifter which will sift the ashes as they are discharged from the grate bars thereby separating the cinders from the ashes, and retaining the cinders in one receptacle and the ashes in the other, to provide for convenient and ready handling.

ANTI-FRICTION BUFFER.—L. LARSEN, Apartado, 150 Tampico, Mexico. The invention relates more particularly to an anti-friction buffer for docks, wharves, ferry slips, ships and the like, which is adapted to absorb the shock of the impact when a ship is being docked, or when two or more ships are lashed together for towing, the object being to prevent damage to the ships from friction.

STORE COUNTER.—F. H. COLE, Yuma, Colo. The invention has for its object to provide a store counter especially adapted for use in grocery stores, for making up orders, wherein the counter has a series of compartments, each provided with a sliding cover arranged to be slid to one end and stood in vertical position, the covers bearing the names of the customers whose order are to be filled.

HOLDER FOR CARBON SHEETS.—W. S. FREEMAN, 55 Worth St., New York, N. Y. The object of this invention is to provide a device consisting of a cap so connected with the end of the sheet that sheets of paper may be arranged on the opposite sides of the carbon sheet with their ends in the cap, to permit the instrument to be written and the carbon copy made while the sheets are so held, a second cap being provided for enclosing the folded sheet and carbon for protecting the same.

Hardware and Tools

DOOR HANGER.—B. SPITZFADEN, c/o Elevator Efficiency Co., 51 Maiden Lane, New York, N. Y. The invention relates more particularly to ball bearing hangers for heavy doors. The general object is to meet the severe conditions by providing a construction of parts that will resist heavy strains and at the same time will maintain the door in proper alinement against all tendency to become loose.

STOVEPIPE LOCK.—G. W. HORMEL, 115 N. Wabash St., Wichita, Kan. The invention relates to locks for securing stovepipe lengths together. An object is to provide a simple and effective lock for positively uniting the meeting ends of adjoining stovepipe sections by means of a movable locking member which engages with a stationary member.

WINDOW LOCK.—D. SPIVAK, Room 406, Chamber of Commerce Bldg., New Haven, Conn. Among the principal objects of the invention are to provide a lock of the character mentioned which may be placed in service to provide for window ventilation and secured in such a manner as to prevent tampering with the lock, and to provide a lock the cost of production of which is small.

ROWING GEAR.—D. MCRAE, Central Islip, N. Y. The invention relates more particularly to rowing gear in the form of oar locks, which will reduce the friction incurred by the oar when making the stroke or feathering, the oar lock as constructed having a groove

A FRAGMENTARY VERTICAL SECTION AND DETAILED VIEW

formed in the inner face of the stirrup, and anti-friction members arranged therein, and means for retaining said members in the groove, the anti-friction members constituting a bearing surface for directly receiving an oar.

CLAMP BOLT.—E. J. RUQUET, JR., 1637 Richmond Road, Stapleton, S. I., N. Y. In ship and bridge building, it is often necessary to employ temporary means for holding plates together while the permanent rivets are being driven. The present invention provides a temporary bolt clamp for this purpose. The clamp is simple in its application and may be applied or removed very quickly.

DOOR SPRING.—J. A. CAMPBELL, Carbondale, Ill. This spring is of the type adapted to be concealed within the frame of the door and jamb. It automatically tends to keep the door in a normally closed position and limits to a predetermined degree its outward swing when pushed open. It aso locks the door in its extreme open position.

WELL DRILLING TOOL.—W. A. MCCAUSLAND, 4072 Jenkins Arcade Bldg., Pittsburgh, Pa. The present invention is an improvement in a construction disclosed by Mr. McCausland's previous patent No. 1,211,198. The improved feature of the invention lies in the construction of the stem or middle section of the drilling tool, which includes a tube having a filler with a member embedded therein, the ends of said member projecting beyond the ends of the tube to provide anchoring means whereby the stem is secured to the drill jar and bit respectively.

Heating and Lighting

FLUE EXTRACTOR.—P. M. CANTY, 909 6th Ave., Altoona, Pa. An important object of the invention is to provide a flue extractor which will so effectively and powerfully engage the flue that the enormous pulling force

necessary to withdraw the flue may be applied. Another object is to provide gripping elements of strong and durable structure, with means for positively withdrawing the gripping elements from engagement with the flue when desired.

TUNNEL KILN.—F. J. LEISEN and E. S. DUNN, 1229 3rd Ave., Huntington, W. Va. The invention relates particularly to the type of kiln known as a tunnel kiln, wherein the articles to be burnt are mounted upon movable carriers, these carriers being intermittently advanced through the kiln and subjected to various degrees of heat so that each carrier with its load enters one end of the tunnel with dried material, and emerges from the opposite end with the burnt articles, which are then subjected to cooling drafts to permit of their rehandling.

SOLAR STEAM GENERATOR.—A. V. FOLSOM, 1121 E. 42nd St., Jacksonville, Fla. An object of the invention is to provide a solar steam generator the principal features of which consists of suitable means for containing water, disposed in such a way as to be heated by means of the rays from the sun through the instrumentality of a reflector for concentrating the rays thereon, means also being provided to turn the reflector in such a way as to always keep it facing the sun.

Machines and Mechanical Devices

COIL WINDER.—L. F. STRATTON, 21 W. 5th St., Charlotte, N. C. The primary object of this invention is to provide a coil winder by which coils of various sizes and designs may be wound. The invention furnishes a comparatively cheap and simple device which is capable of various adjustments on which the wire may be coiled in a most convenient and practical manner.

CENTRIFUGAL ORE SEPARATOR.—J. A. RICE, Berkeley, Cal. This machine is especially adapted to separate such materials as mineral particles from mill dust, from flue dust, or bag house products, digerent minerals constituting concentrates, liquids differing in specific gravity, and gases such as furnace gases from smelters, where it may be desirable to extract finely divided dust particles, or to separate two gasses differing in specific gravity.

Medical Devices

MEDICATED PESSARY. — MARTOCCI-PISCULLI, 235 2nd Ave., New York, N. Y. Among the objects of the invention is the construction of a pessary which shall be entirely self-contained, which may be made of any suitable material, and which will have incorporated in it means permitting an evaporable germicidal agent to be associated with it.

Prime Movers and Their Accessories

AUTOMATIC GOVERNOR.—F. J. BRUMME, Cooksville, Ill.—An object of the invention is to provide an automatic governor designed to be attached to certain portions of an internal combustion engine and actuated by the operation thereof, whereby the flow of fuel through the carburetor is automatically controlled, and can be adjusted at will while the engine is in motion. The device is compact in form and takes up little space.

INTERNAL COMBUSTION ENGINE.—T. B. CASEY, 306 Sewell Apt., Vallejo, Cal. The invention has reference more particularly to means for introducing a scavanging medium in the combustion chamber to effect a complete exhaust of all spent gases incident to the firing of the explosive charge, and thus render the combustion chamber better adapted to receive and fire the explosive charge, whereupon the engine will be capable of operating with a higher degree of efficiency.

VAPORIZER FOR HEAVY OILS.—C. C. MANKER, Mayfair Apts., 40 St. James St., Los Angeles, Cal. This vaporizer for heavy oils such as kerosene and the like, is adapted to be attached to an automobile to furnish the motive power for the same. Means are provided for automatically regulating the quantity of the vaporized products. The oil vapor is mixed with steam which eliminates carbon deposits from the interior of the engine.

Railways and Their Accessories

SWITCH ADJUSTMENT HOUSING.—R. R. BAKER, 7758 Lagoon Ave., Chicago, Ill. An object of the invention is to provide a housing for switch adjustment that is simple in construction and operation and not liable to easily get out of order. A further object is to provide a casing to prevent snow or sleet from clogging the adjustable connections and preventing adjustments being made until such snow or sleet is removed.

SWITCH LOCK.—P. H. MYERS, c/o Sanatorium, Hainburg, Pa. The invention aims to provide a device by means of which when the point of a switch has once been thrown it would be impossible for this point to shift subsequently unless directly operated by some outside agency. The switch lock is so constructed that it may be operated entirely by mechanical means.

Pertaining to Recreation

GAME.—H. M. THOMPSON, R.F.D. No. 12, Brownsville, Me. The object of this invention is to provide a device having a game board in the form of a map of some specified country, provided with route lines and with stops indicated on the lines, together with markers for indicating progress along such route lines, the progress of the counters being determined by game pieces, as, for instance, dice.

ROCKING HORSE.—W. DICKINSON, 608 W. Sharpe Ave., Spokane, Wash. The invention has for an object to provide an article of furniture for the use of children. A detachable seat is provided which may be secured to the arm of a rocking chair, an upright formed to simulate the head of a hobby horse, and a clamp for securing the seat to the arm of the chair so that when not in use the device may be removed.

Pertaining to Vehicles

SLEIGH RUNNER ATTACHMENT FOR BABY CARRIAGES AND OTHER VEHICLES.—H. FLECKL and W. J. BOYD. Address Hans Fleckl, Boyds, Wash. The invention provides a sleigh runner attachment particularly adapted to be attached to a baby carriage. The runners may very quickly be raised to permit the carriage to run on its own wheels or be moved down into engagement with the snow or ice, lifting the wheels from the frozen surface.

VEHICLE WHEEL.—C. E. P. JULIEN, 41 Boulevard Haussman, Paris, France. The invention provides an additional wheel rim applicable to all kinds of vehicles but intended more particularly for tractors, agricultural machines and any motor vehicles required to travel over hard roads and soft ground. The auxiliary rim is provided with V-shaped projections which will project into the ground when traveling over a soft surface but which will not contact with the ground when traveling over a hard surface.

TOOL FOR USE IN REMOVING AND REPLACING TIRES.—V. H. MANKEY, 1110 So. Kline St., Aberdeen, So. Dak. The prime object of the invention is to provide a tool whereby the rim can be quickly displaced or restored in a manner to minimize the possibility of injury to the rim. A further object is to provide a tool that may be quickly placed in position gripping the respective ends of the rim and then the clamps be relatively moved through the medium of an ordinary wrench so that the displacing of the rim or the restoring of the same can be effected in a few minutes.

AUTOMATIC CLUTCH DIFFERENTIAL ESPECIALLY FOR MOTOR CARS.—R. W. A. WARREN, Katanning, West Australia, Australia. The invention relates to an automatic friction clutch differential, which is designed to make use of the considerable centrifugal force or momentum of the car and passengers under which, when turning a corner, the car body and consequently the axle housing tends to continue in a straight course rather than to move with the wheels in the new direction.

PIPE LOCK.—E. BAKLEY, R.F.D., Chatham, N. J. The invention relates to a device for locking a pipe through which fluid is adapted to flow, so as to prevent the passage of any fluid. It is especially constructed for use in connection with an automobile to prevent the theft of the same by cutting off the connection between the gasoline tank and the carburetor but in such a manner that it may be instantly opened by the owner without the use of any special key.

The Aerial Cruiser

(*Continued from page 409*)

etc., and the sleeping accommodation consists of hammock bunks. Meals are cooked in special cookers heated by the exhaust from the engines.

Streamlining and Efficiency

The most careful attention has been given to the design of the cars with the result that a great increase in aerodynamical efficiency has been obtained over the cars of R-33 class airships. By making all the cars of the best known streamline shape, the head resistance as compared with R-33 class cars has been reduced by over 60 per cent, and the utilization of the fine nose of the control car as an observation station for the use of the navigating officer gives exceptional facilities for groundwork, which are not obtained in other designs.

The cars themselves are designed on a principle which enables the weight, as compared with similar cars of R-33 type to be cut down by over 50 per cent with greater strength and rigidity of structure. More roomy cars are therefore provided, the beam of the control car being eight feet as against a maximum of six feet on R-33 class.

Mooring

Costly experience in the early days of the Zeppelin experiments showed that the greatest peril to the airship occurred when it came near the earth, and several years ago the SCIENTIFIC AMERICAN pointed out that some form of mooring post to which the dirigible could make fast was necessary if landing disasters were to be avoided. The problem has been very ably worked out in the Vickers mooring gear, and R-80 carries in her nose the necessary gear for sailing up to one of these posts and making fast. A covered gangway can be thrown across from the moored airship to the mooring post through which the passengers pass to elevators arranged within the post. Gas, oil and water pipes form a permanent part of the mooring-post equipment, and they are provided at their upper ends with suitable connections for supplying the airship.

Preventing Rust at High Temperature

(*Continued from page 404*)

shapes, lengths and sizes. Straight pipe ⅛ inch to 18 inches diameter has been calorized in lengths up to 20 feet. There is no limit to the size of material which may be treated. Calorized steel is particularly adapted to pyrometer protection tubes because of the high temperature to which they are exposed. Not only is it cheaper than any of the chrome steel alloys which have at times been offered for this purpose, but it possesses other advantages.

Perhaps the largest and most easily developed field for calorizing lies in its application to the various pots, boxes, tubes, retorts, and special equipment employed in the many heat treating processes. A large quantity of the above mentioned articles have been successfully calorized, their average life being over eight times that of the uncalorized equipment, resulting in a great saving. A notable feature is that calorizing can be applied to any of this equipment without necessitating change in its design or construction.

Many furnaces, kilns, ovens and retorts employed in various manufacturing processes were originally made of iron or steel. This metal has a limited heat-resisting quality and was reduced to scrap in a short time. It was repeatedly replaced, its life being short because of the excessively high temperatures and the same performance continued indefinitely. As the price of the metals increased, the use of the other materials was considered by engineers in an effort to reduce costs. They built these furnaces from fire-brick and various refractory materials. In a great many instances these materials were used at a loss of

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25 to 75 per cent efficiency, but were adopted because the repair costs on iron and steel were prohibitive. Calorizing can be applied to metal furnace lining, baffle plates, etc., the cost of these calorized plates per unit of service being in a great many cases much less than that of refractory materials. There is an unlimited field for calorizing as applied to equipment of this nature.

There are many possible applications of calorized metal which have not been considered, for the reason that only within the last six months has calorizing been available to the commercial world. It is impossible to enumerate or describe in detail the great number of applications. Every plant presents its individual problem and it is the object of the writer to illustrate several applications with the idea of suggesting to the engineer, metallurgist, and plant manager, possible applications to special equipment used in his particular process of manufacture.

A Pocket Machine Gun

(*Continued from page 405*)

obliged in his work to sit behind various machine guns in erosion, function, and ballistic tests for a matter of six months or more, and he was not impressed at the end of this time with the reliability of function of any machine gun at present used by civilized armies, examples of which we tested. Used under the most favorable conditions, in the hands of skilled mechanics, they all were made to look simply childish in certainty of function and endurance when compared to that other gas engine—the motor of the small car. A stoppage, a broken part, a jam—one of the three would occur with the most reliable machine gun of them all, the Browning, about every 1,000 rounds fired.

One thousand impulses of any given cylinder in the auto motor will, in high gear, run the little car something like a mile, and a hundred-mile run means that each cylinder has fired a hundred times as many "shots" as the machine gun averages between bits of trouble. Not even the most pessimistic of car owners will deny that the motor will run the car a hundred miles without stop, jam, or break.

I cheerfully admit the difference in conditions, such as the far greater pressure of the machine gun and the higher speed of the parts; but still I believe that there is not enough difference in conditions to justify the wide difference in reliability between the two types of gas engines. Possibly, therefore, the decision of the latest entrants into the machine gun market to use lubrication is based on sound judgment. There is also the possibility that they are making a virtue out of a necessity.

The new gun is arranged to fire any pistol cartridge, the change necessary being merely in barrel, magazine and bolt-head. Special cartridges containing buckshot will also function the gun, and make for close-up work a tremendously effective weapon.

The writer, after firing the gun several hundred rounds, would class it as the equal of a score of average policemen firing as the average policeman fires, provided of course the gun were fired by a man accustomed to it. And of course it is far easier to train one man to become expert with the gun than it is to raise the shooting of twenty policemen to the expert stage with their pistols.

There would be no trouble whatever for one man firing the gun to sweep a street clear from curb to curb, but after all, its greatest strength lies in its moral effect. Killing many of the common American sort of mob is unfortunate unless the right ones can be selected for the slaughter. Mobs as a rule are composed of ten per cent vicious (the leaders), and ninety per cent fools. Wherefore the dispersing of the crowds without bloodshed is usually desirable. It would be a most vicious and determined

CONDITIONS FOR THE $5,000 PRIZE EINSTEIN ESSAY CONTEST

1. No essay shall be longer than 3,000 words.

2. All essays must be in English, and written as simply, lucidly and non-technically as possible.

3. Each essay must be typewritten, and identified with a pseudonym. The essay shall bear a title and the author's pseudonym *only*, and must be enclosed in a plain sealed envelope likewise bearing this pseudonym. In the same package with the essay must be sent a second plain sealed envelope, also labelled with the pseudonym, and containing a statement of the name and address of the contestant, the pseudonym used, and the title of the essay. It is necessary to follow these instructions implicitly, in order to guard against confusion in opening the envelopes and assigning the pseudonyms to their proprietors, especially in view of the possibility that two of the contestants may employ the same pseudonym. The envelopes should be sent in a single package to the Einstein Prize Essay Editor, SCIENTIFIC AMERICAN, 233 Broadway, New York.

4. All essays must be in the office of the SCIENTIFIC AMERICAN by November 1st, 1920.

5. The Editor of the SCIENTIFIC AMERICAN will retain the small sealed envelopes containing the competitors' names and addresses, which will not be opened until the competitive essays have been passed upon and the winning essay selected.

6. As soon as the judges have selected the winning essay, they will notify the Editor, who will open the envelope bearing the proper pseudonym and revealing the competitor's true name. The competitor will at once be notified that he has won, and his essay will be published in an early issue of the SCIENTIFIC AMERICAN.

7. There shall be but one prize, of FIVE THOUSAND DOLLARS, to go to the author of the best essay submitted.

8. The SCIENTIFIC AMERICAN reserves the right to publish in its columns, or in those of the SCIENTIFIC AMERICAN MONTHLY, or in book form, any of the essays which may be deemed worthy of this. Aside from such rights, the essays shall remain the properties of their authors; but no manuscripts can be returned.

9. The Committee of Judges will consist of Professors Leigh Page of Yale and E. P. Adams of Princeton. In the event that they are unable to agree on the best essay, the Einstein Prize Essay Editor will cast the deciding vote.

aggregation that would stand up to the fire of one of these guns, after a couple of bursts had been fired over their heads or into the street in front of them. Moreover, one of the guns, mounted on a patrol wagon or automobile would riddle a car attempting to run by or to escape via the stern-chase route.

The cartridge selected for this gun is a most formidable one. Its bullet of 220 grains is 80 grains heavier than the bullet of our service rifles and machine guns, and its caliber, .45, as compared to .30 ensures that when it hits, it will strike a knock-down blow. The low initial velocity, less than a third that of the service rifle, and the stubby form of the bullet prevents it from having much range; which lack of carrying power is a most desirable thing in settled communities. The Ballistic Station found the extreme range of the cartridge to be 1,400 yards, with 500 yards as probably its effective range.

The locking bolt of the arm is worthy of notice as embodying a new principle in machine gun and self-loading arm mechanism. It consists of a wedge, sliding nearly vertical, and locking the barrel extension and receiver together. Its slots are cut at an angle of about 80° with the axis of the barrel and its extension. It was found years ago by Commander Blish of the United States Navy, the inventor of the device, that a wedge so arranged would hold while the breech pressure of the exploding cartridge remained high, but the instant or as soon as the bullet left the muzzle, the adhesion between wedge and its slots ceased, and the remaining backward pressure would compel the wedge to slide downward and unlock the breech mechanism. The principle applies to other forms of breech mechanisms, where the locking is done by cams without a final bearing at right angles to the line of backward thrust.

Thus, some years ago, a coast defense gun, firing blank cartridges, giving of course low pressure, insisted upon unlocking itself and coming open each shot.

This was very alarming because it was apparent that if the breech would cam itself open during the firing of low pressure blanks, then fireworks and trouble could surely be expected when firing high pressure service charges.

On trial, however, it didn't work out, the gun stayed locked beautifully with the service and high pressure charges. Here evidently the adhesion of the locking surface set up by the high pressure charge did not free in time to permit the subsequent falling pressure to unlook the gun and open it.

The writer found the same phenomenon when testing a well-known sporting rifle with greased cases. This rifle has a locking bolt which works in slots cut at nearly right angles to the horizontal bolt. The finger lever operating the mechanism normally has a catch to hold it closed, but here the catch was broken, the parts were worn and free and the case itself was greased.

The result was that the horizontal bolt would open during the firing, drawing the fired case with it. It did not "blow" open, that is it did not open during the height of the pressure and permit the escape of gas; it came open when the pressure had evidently fallen enough to free the locking surfaces of the vertical bolt, and permit the little remaining pressure to drive the breech bolt backward. The Ross sporting rifle was another weapon which would at times perform this trick if the rocker arm on the sear, which normally holds the sleeve closed, were removed, or was too short to reach up on the pulling of the trigger and hold the sleeve from backward movement. In this case, particularly with the cartridge case greased, the sleeve would slide open, taking the case with it. This was not a violent action, and there was no evidence of high pressure or gas. It was evident that when the gas pressure in the chamber fell, the bolt would cam open, just as did the interrupted-screw block of the coast defense gun referred to.

In the Submachine Gun, the joint invention of General John T. Thompson, retired, former Chief of the Small Arms Division during the war, and Commander Blish of the Navy, this same principle is used, the wedge locking bolt holding firmly while high pressure persists within the chamber, unlocking when the pressure falls, and permitting the bolt to slide back and the various parts of the mechanism to function.

It is question how much friction enters into this sort of locking arrangement, and therefore how much of the oiling system adopted is a matter of necessity.

The fact remains that the gun functions at extraordinary speed and with more than normal machine gun reliability. With its small size, its light weight, its tremendous rate of fire, and its ease of control, the recent New York acquisition is probably the most efficient man killer of any firearm yet produced. A well-known American factory is producing 15,000 of them—destination and purpose not announced.

What Science Did for Cheese

(*Continued from page 406*)

record although much of this native product was of low grade. With the perfection of new commercial system of cheese manufacture, not only is dairying promoted in sections of the country far from city markets and adequate railroad transportation, but the standardization of Swiss-cheese-making also promises that we will produce our potential supplies at home and also may devote considerable of our surplus to export trade. At present one plant in California is manufacturing Swiss cheese on a large scale according to the new system of production. This factory will produce over $2,000,000 worth of Swiss cheeses this year while it has already exported two carloads of the product to Switzerland where the cheese was sold on the open market and was complimented as being better than the best of the domestic offerings.

Another notable accomplishment of the National Dairy Division has been the perfection of modern methods of Roquefort cheese production so that this delectable delicacy can be made from cow's milk and cured under artificial conditions, the finished product being as good as, if not better than, the expensive, imported Roquefort which comes from France and is made from sheep's milk. For twenty centuries, Roquefort has ranked as the king of all cheese. It has been made by the peasants of southern France who live near Roquefort and maintain approximately 500,000 sheep especially for the production of milk from which to make the cheese. During their six months' lactation period some of the ewes produce enough milk individually to make 50 pounds of cheese. The cheese, for the most part, is made on the farms and small factories of that neighborhood and subsequently sent to Roquefort where it is cured in the famous caves of that region—formed by the slipping of rock at the base of the Cambalou Mountains.

Currents of cool moist air circulate freely through the caverns and galleries and are aided in their natural refrigeration and curing of the cheese by the numerous streams of mountain water which wind hither and thither among the grottos. When the moist air currents strike the rocks, rapid evaporation occurs which is invaluable in lowering the temperature to about 40 degrees Fahrenheit. During recent years some of these natural subterranean ice-boxes have been enlarged and equipped with artificial means of refrigeration so that even lower temperatures than naturally obtain can be produced. The fact that cheese is produced at country points and concentrated at Roquefort

for curing suggests a possibility for the improvement of the manufacture of similar cheese in this country and the ultimate assembly of all the material at one central point for curing. Such an arrangement would minimize the expense and also would operate for the production of a superior quality product of uniform grade.

The Federal farming scientists in this country, for a number of years, have been experimenting with the potential purpose of perfecting the manufacture of a green mold cheese from cow's milk. For many years the attempts all resulted in failure and the experts ascertained that it was not sufficient merely to sprinkle green mold on the curd to produce Roquefort cheese. It was only with the greatest difficulty that the mold was made to develop properly; this process, at best, was very unreliable while available systems of refrigeration were not adequate, subsequently, for the proper curing of the dairy product. A low temperature was prerequisite, with plenty of ventilation and high humidity.

Finally, the Government dairying specialists devised a special air-conditioning apparatus which filled the bill to a T and which duplicated the natural conditions which obtained in the caves of Roquefort. As a result of this invention combined with the perfection of a process which permitted the substitution of cow's milk for goat's milk—as little of the latter material was available in this country—modern science has standardized Roquefort cheese manufacture and adapted it to our local conditions as efficiently as it solved the Swiss cheese riddle.

Before giving world-wide publicity to its new discoveries, the National Department of Agriculture produced both Swiss and Roquefort cheeses on a commercial scale for wholesale and retail trade at the Grove City, Pennsylvania, creamery, which is operated under the coöperative direction of Uncle Sam. During the last couple of years this cheese has been sold on the open market in active competition with the best grades of imported cheese with flattering results indicative of the superiority of the domestic product. In the case of the Roquefort cheese, some slight criticism has developed due to the fact that the color of the cheese made from cow's milk is yellower than that of the imported Roquefort made of goat's milk. This obtains from the fact that the fat of sheep milk naturally is whiter than that of cow's milk. However, it is anticipated that, as the domestic industry develops and more scientific attention is devoted to the study of cheese manufacture, additional perfection and improvements will result which will eliminate all existent sources of unfavorable comment.

Safety for the Linemen

(*Continued from page 407*)

slightest pinhole or other defect that might admit of the passage of an electric discharge through the glove.

Each glove is filled with water to within about two inches of the top, being soused in the water for an equal distance from the top. Scientifically expressed, one terminal of a "step-up" transformer is then connected to the water inside the glove and the other to the water outside the glove. By the application of a regulating and measuring apparatus, not shown in the accompanying photograph, the voltage is raised to the specified value and maintained for five minutes, or until the glove "breaks down" or yields to the electric stress. The fact that occasionally several gloves in a single consignment cannot withstand the searching eye of the experiment emphasizes the value of periodic tests.

Rubber gloves purchased by Uncle Sam for use at the Panama Canal are tested by the Bureau of Standards before they can qualify for service. The stress is applied at 9,000 volts, a voltage higher than that required by active usage. Similarly, progressive electric power companies have

the rubber gloves used by their linemen tested when new and at specified intervals while subjected to service. Rubber deteriorates with age and use, and the life risk involved in outfits for workmen emphasizes periodic testing as an indispensable practice.

Concerning Back Numbers

WE beg to advise our readers that all back numbers of the SCIENTIFIC AMERICAN within the current year, that is to say, 1920, can be furnished at a uniform price of 15 cents each, with the exception of our "Anniversary Number," which is 25 cents. All issues of the SCIENTIFIC AMERICAN back of 1920 can only be sent on receipt of 25 cents and only those numbers which are in print can be supplied. To avoid unnecessary bookkeeping, all orders should be accompanied by a remittance to cover the cost of the same. Back numbers of the SCIENTIFIC AMERICAN SUPPLEMENT for 1919 can still be supplied until January 1st, but earlier numbers as far as the supply goes can be purchased of the H. W. Wilson Company, University Avenue, New York City, to whom all inquiries regarding SUPPLEMENTS are referred. We are able to supply back numbers of the SCIENTIFIC AMERICAN MONTHLY, all issues for 1920 except August and September which were not published, for 50 cents each.

Propping Fruit Trees with Staples and Wires

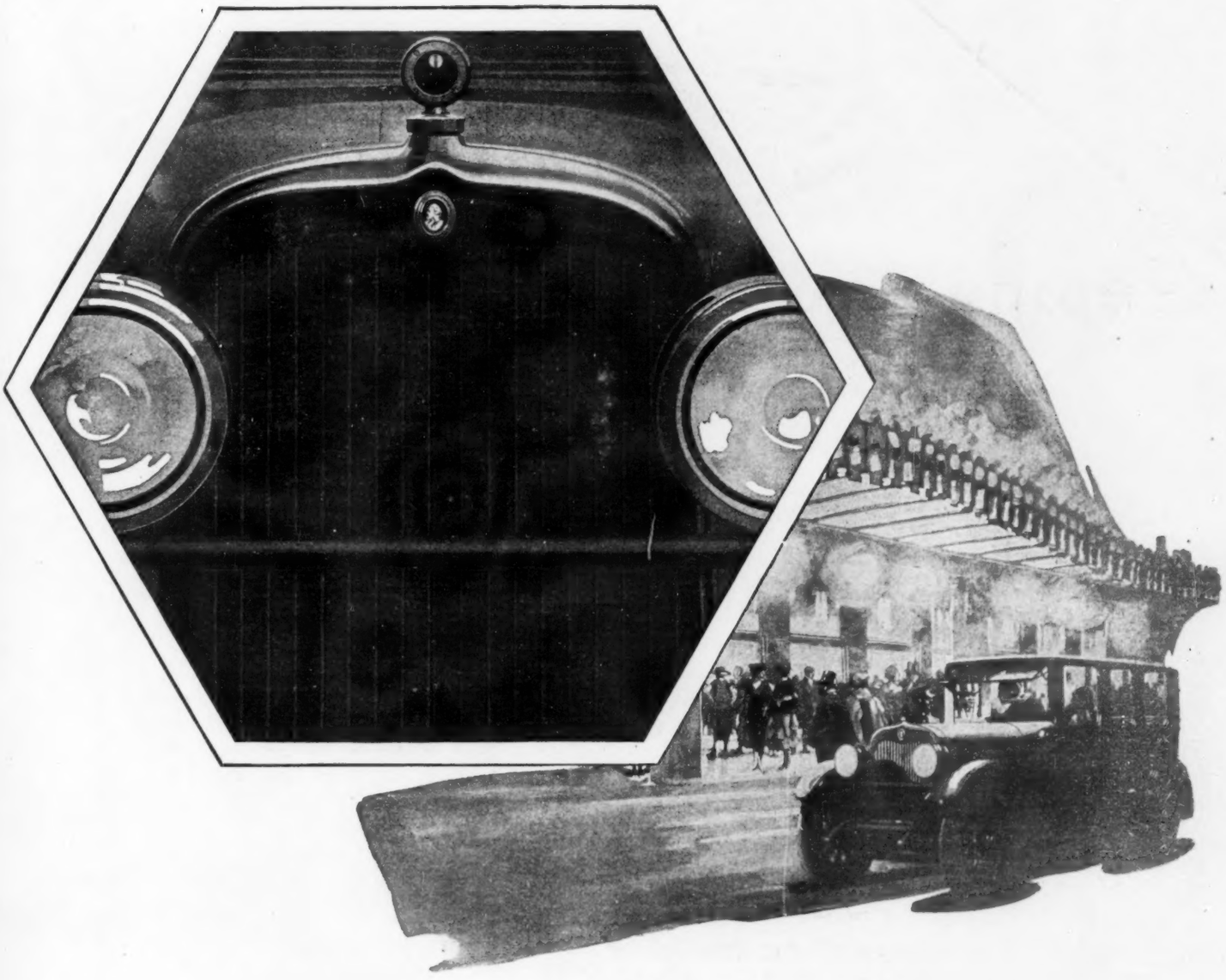
THE fruit tree with a fruit load much too heavy for its own trunk and limb structure isn't an unusual occurrence in either the small home orchard or the big commercial one. The common way of providing supports for such trees is to use wooden props, sawed out of scantlings. When wooden props first were used, lumber was cheap and easily obtained. This condition has radically changed, and the cost of props, used in any number, is a serious additional cost. Another drawback to props is that they require frequent attention. A storm comes, the wind blows hard—and props are down all through the orchard. When props are used, cultivation beneath the trees is interfered with.

Propping with staples and wires is a growing practice in California fruit districts. It is a method which requires some skill and judgment, but when properly done is economical and efficient. One wiring does for several years. The cost of the method is only a fraction of what propping with wood costs.

California expert orchardists find that the best time to prop is just before the fruit tree branches have become to bend under their load. In wiring, the endeavor is to attach wire to branches at the point where the center of the load will come. Two methods can be pursued. One is to have a central iron ring, within the tree, with wires running from it to the branches needing support. An advantage of this method is that if a wire breaks, only one branch is released.

For most trees, however, the more practical method is to run one wire around the branches requiring support, holding them in and together. Twelve or 13 gage wire is used. Fourteen gage is too light, while an objection to 12 gage is that, though very strong, it is hard to handle. So growers frequently compromise and use 11 gage. The wire is attached to the limb with a two-inch fence staple, except in the case of very small limbs, when a large picture screw-eye is used. Screw-eyes are used when a staple would split the wood.

In wiring, the endeavor should be to hold the tree in its natural position. If this is well done, the growing load of fruit will operate simply to strengthen the tree in its proper shape. If the tree is not well wired, there is still danger of damage from spreading when the full load begins to be felt.—By *J. T. Bartlett.*



There is a charm—a distinctiveness in the appearance of Harrison equipped cars, discernible at a glance. But it is not alone external grace that distinguishes such cars. Appearance here is but an assurance of high grade performance, for motor efficiency winter and summer is definitely increased by the dependability of Harrison Radiators.

How well this is recognized by leading motor car manufacturers is indicated by the increasing number of quality cars being equipped each year with Harrison Radiators. The Harrison automatic shutter controlled radiator is a feature of all Lafayette Cars.

Harrison Radiator Corporation

General Offices and Factory: Lockport, N. Y.
General Sales Offices: Detroit, Michigan

HARRISON *Shutter-Controlled Hexagon* Radiators

Keeping Pace with Truck Progress

Conditions are fast changing in the truck building industry.

The fires of unusual demand brought about by post-war conditions have passed—a more stable period of sane and conservative truck buying has come—to stay.

In the wake of this period come the natural rumors of depression—of the curtailment of production on the part of some companies because of this lessened demand.

But from it all the Federal Motor Truck Company has emerged, confronted, not by the problems of curtailed production—but by the problem of greatly increasing it.

New Federal factories are in the building—a greatly increased production schedule is being pushed energetically to meet this steadily increasing demand for more Federal trucks.

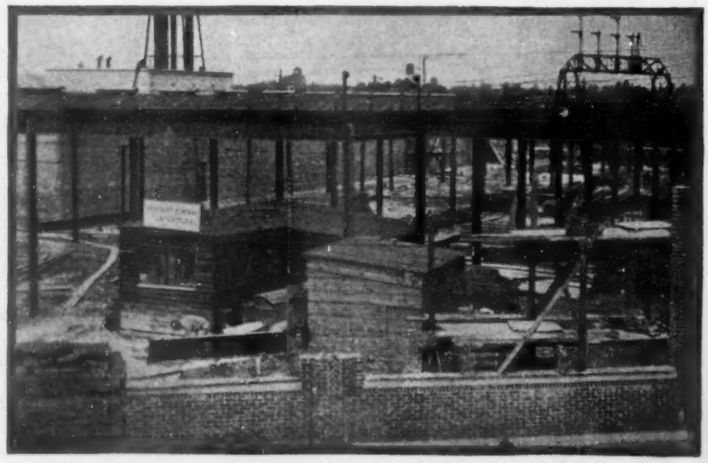
Vigorous and virile—sounder in organization and in the good will of the great truck-buying public than ever, Federal is destined to play a leading part in molding the future of the industry—fated to be among the pacemakers of its achievements.

For that is the spirit of the Federal organization—and that spirit reflecting, as it does, the needs of the nation, records itself indelibly in the achievements of the times.

Federal dealers, everywhere, need more salesmen. The rapidly increasing demand for Federal Trucks must be met promptly by immediate additions to the present Federal sales force. The opportunity to ally yourself with a permanent, profitable business enterprise is yours NOW. See the Federal dealer nearest you or write the Federal factory.

Federal Motor Truck Company, Detroit, Michigan

Another **FEDERAL**



New Federal factories adding over 60 000 square feet to the present factory space are being rushed to completion. In addition to this the Federal Motor Truck Company has recently acquired 60 acres of additional land to provide for future expansion.